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Headquarters Office: 55 West 42d St., New York 36, N.Y. Cables: Somopict Telephone: LOngacre 5-0172

Executive Secretary: CHARLES S. STODTER

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A Method for Controlling the Gray-Scale Equivalent of Colors Used in Live and Filmed Television Scenic and Graphic Art

By WILLIAM J. WAGNER

Compatible color television imposes a new requirement on the material used for broadcasting. Not only must a pleasing color picture result but also the monochrome picture must be satisfactory. These results may be accomplished through the use of artists' colors which have been tested in the broadcast station. The ChromaCHron palette is devised and tested to meet the needs of color television broadcasting, for best appearance of the final picture in both color and black-and-white.

When a gray card is photographed with a motion-picture camera and is framed so that it completely fills the screen, the recorded value is dependent on the type of film, the illumination, the angle of light, length of exposure, the age of the film, condition of chemicals during processing, and many other variables.

When finally projected, the illumination of the room can change the effective value. In a dark room the gray is brighter; in a lighted room it may be completely washed out. The distance projected affects its brightness.* When the film is viewed through a television system, the effective value of the gray is dependent on the type of home receiver and on the technician shading the picture. The transmitted brightness can be altered by the home viewer, and the illumination of the room would influence home receiver adjustment.

The gray by itself has little meaning. It symbolizes a blank screen. Two grays in the picture alert the eye because they can be compared to one another as to their size, shape, or value.

A gray in one setting is not necessarily that same effective value in another setting. For instance, if a medium gray is surrounded by a lighter value, the gray appears dark. That same gray appears lighter if surrounded by a darker value. If the second surround is dark enough, the surrounded medium gray can appear as light as its earlier surround. This experience is accentuated in the dark room when the grays are viewed either by motion-picture projection or by television transmission. To the eye, a gray is only that particular gray depending on its surround or its environment.

The TV artist is not conscious of this type of experience. He selects grays for a picture because they go well together and have adequate contrast for the desired effect. There is always the awareness that the selection of gray can be altered during transmission and/or reception. This does not mean that every picture could be a total failure in the home. The viewer adjusts his receiver so that it best satisfies his taste and is adequate for his needs. A poor picture, one that has soft contrast or one that has harsh contrast, suffers most and keeps the viewer busy adjusting contrast and brightness knobs.

The experienced TV artist never knows how his grays will transmit but understands that a certain range of grays transmits best together, will not exceed the system's light reflection limitations and, if placed in proper relationship, will have adequate contrast.

Planning Color for Monochrome Reproduction

Once having learned this, color television comes into being and brings about other problems for the artist. Intelligent and artistic color selection is not enough. The gray equivalents of the colors are just as important. Due to the large percentage of black-and-white receivers, a good color picture which lacks gray contrast is not usable for television. The artist still must work with gray harmonies, but is at a loss as to what the gray equivalents of his colors are.

It is difficult enough to understand just what a gray is when dealing with grays alone. There is the consolation that, regardless of physical value or density, if a picture in grays looks right it is acceptable. This does not work in color. Just because a color picture appears to have color contrast does not mean that it has black and white contrast. Sometimes contrast is accentuated by surround or environment. When dealing in color, this experience is called "Induced Color" or "Chromatic Induction." Not only does it appear to cause value changes, but also color changes.

A surround can induce changes in color.† The surrounding color induces its complement into the surrounded color. This in turn could give the surrounding color the appearance of being more saturated or less saturated, depending on what the colors are.

One must be aware that, due to this experience, the artist can become confused as to the gray equivalents of his colors. These are difficult enough to determine when a color stands by itself, let alone when it is surrounded and affected by other colors. More difficult is the prediction of what the gray equivalent of a color is when viewed through the live TV system. Trying to determine the gray equivalent of a color when photographed on a certain type of color film

Presented on October 9, 1957, at the Society's Convention at Philadelphia by William J. Wagner, KRON-TV, 929 Mission St., San Francisco 19.
(This paper was received in final form on May 1, 1958.)

* "Brightness: attribute of sensation by which an observer is aware of differences of luminance," p. 365, Glossary-Index, *The Science of Color*, compiled by the Committee on Colorimetry, Optical Society of America, Thomas Y. Crowell Company, New York, 1953.

† Although it is not within the scope of this paper to discuss color in the areas of psychology or philosophy, perhaps the reader should be reminded that color is a subjective quantity. Agreement upon a point of reference and terminology does not necessarily mean that each person is "seeing" the same color.

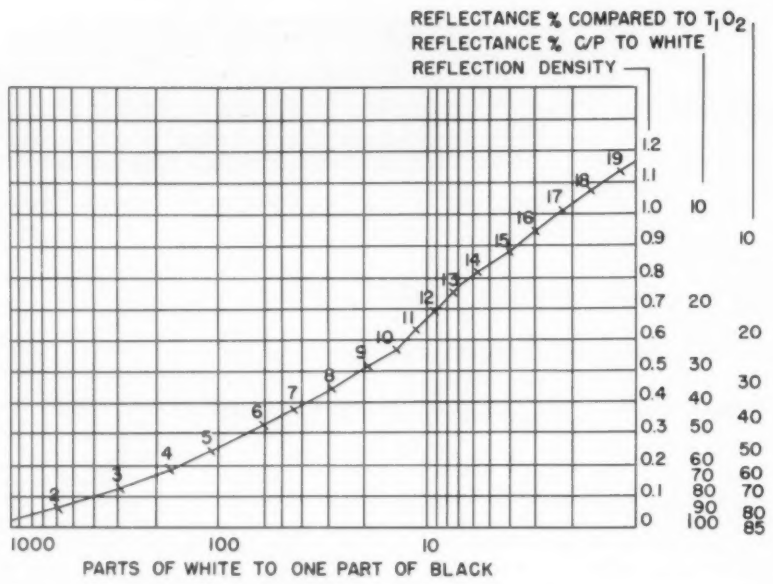

Fig. 1. Reflection densities and formulas for gray-scale steps.

projected through the TV system and viewed in black-and-white is impossible unless the results of previous experiences have been recorded.

Most artists have produced art which has good color contrast but not good gray contrast. It may televise well in color, but give a poor black-and-white picture. Correcting this type of unpredictable error can be costly and embarrassing.

Gray equivalents which are often complicated by chromatic induction are not the only problem faced by the artist. There are more to add to his confusion. Unfortunately few have had training for TV, let alone color TV. They are at a loss when it comes to understanding the 20-to-1 reflection limitation of the color system, and are seldom equipped with tools to measure light reflection, which would enable them to determine the difference between the most reflective and most light absorbing colors.

Economy is vital to art departments. They work on limited budgets, and errors must be avoided. Redoing any art almost doubles its cost. Economy and efficiency require the artist to have an adequate palette, along with a method of predicting gray equivalents.

In a palette the important thing is the selection of color. Each artist selects a few basic colors. Intermixing these colors produces countless variations. These establish his color range. Some call it his gamut; it is his palette.

Using a palette as the basis for understanding the artist's problems in color telecasting, KRON-TV developed ChromaCHron. ChromaCHron does not differ greatly from the artist's palette in choice of color or number of basic colors; however, it goes beyond being just a palette. It is versatile and is designed specifically for television; instead of intermixing colors haphazardly, formulas are given by which mixtures can be achieved. Each has a gray equivalent. There is neither guesswork nor fumbling when a specific mixture or value is desired.

Designing the Gray Scale of Colors

The first step in developing ChromaCHron was the designing of a gray scale. All colors and their mixtures were to have a gray equivalent corresponding to one of the twenty grays in the ChromaCHron scale.

ChromaCHron's selection of a gray scale for color is based upon the measurement of reflectance of ChromaCHron's black and white. The range of this is divided into nineteen equal parts in the terms of reflectance density, thus achieving twenty steps. White is step number one, and black (with a reflectance of 1/20, or density of 1.2) is number twenty. ChromaCHron black and white properly used together in a picture will not exceed the live color television 20-to-1 light reflection limitation.

Figure 1 shows the reflection density of each step of the gray scale and the formulas by which the grays may be achieved when using ChromaCHron black and white. It gives the formulas by which an artist may produce the twenty steps. The reflectance density of each step is also listed.

In addition to the black and white from which the gray scale was developed, five additional water-soluble paints are required for the ChromaCHron palette. These are called yellow, light red, deep red, blue, and green. They are suitable for both scenic and graphic art. These five basics intermix into thirteen hues (Figs. 2 and 3); each hue has seven variations (Figs. 4 and 5).

In determining the gray equivalent of colors, each color was illuminated with 300 ft-c at 3,200 K, at a 45° angle, viewed through a color camera of a color television system on a black-and-white monitor; and the signal was observed on a Tektronix wideband oscilloscope. The camera was balanced against a known value of gray to obtain a minimum chrominance modulation out of the Colorplexer.‡ The luminance signal corresponding to colors of brightness approximately that of the gray was compared with the luminance signal produced by white. The process, including rebalancing of the Colorplexer, was repeated for each step of the gray scale (Fig. 6).

Eastman Color Negative Film, Type 5248 (from which a color print was made with Eastman Color Print Film, Type 5382 and a black-and-white copy was made with Eastman Panchromatic Separation Film, Type 5235) and Anscochrome were used in determining the gray scale of colors after they had undergone their respective photographic process. An Exacta 35mm camera was used with a lens opening of $f/2.3$ at 1/50 sec. Illumination was the same as for live television (300 ft-c, 3,200 K, at a 45° angle). A ChromaCHron gray scale was placed over part of each of the samples of ChromaCHron colors. Slides were made of these colors and projected on a Gray Telojector PT 3 on an RCA TK 26 film chain, and viewed on a Conrac CB 17A black-and-white monitor. The gray equivalent of the color which was the closest to any one of the ChromaCHron grays was given the ChromaCHron gray scale number. The results of the Kodak film are shown in Fig. 7; results of the black-and-white copy of this film, in Fig. 8; and the Anscochrome results, in Fig. 9. Processing of Kodak film was done by Pathe Laboratory, Hollywood, with the attention of Allan Haines, Technical Director. The Anscochrome film was processed in San Francisco by the Elliott Laboratory, under the supervision of Al Elliott.

The following terms are popular with many artists who work with color, particularly with paints.§ This language is applicable also to ChromaCHron.

Hue is pure color (or ideal full color).

Saturation is the degree of hue in mixed color. Desaturation is described in the following terms: *tint*—hue diluted with white; *tone*—hue mixed with gray (black and white); and *shade*—hue darkened with black.

‡ The three signals, red, blue, green, are combined by this device into one signal (the FCC standard signal) which is broadcast.

§ There is, however, a wide range of color terms; see, for example, "Comparative List of Color Terms," a report of the Inter-Society Color Council, Washington, D.C., January 1949.

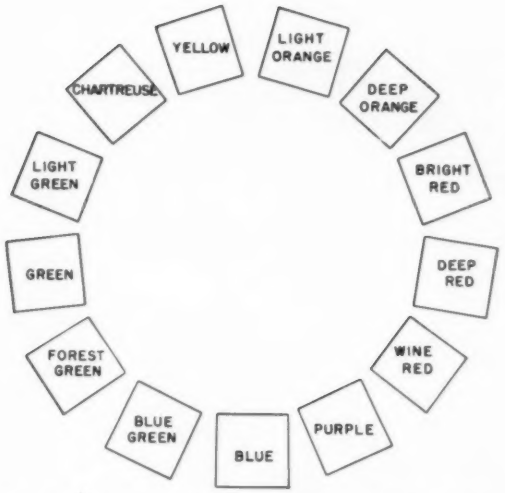

Fig. 2. The thirteen hues of the ChromaCHron palette, arranged in the usual order for such diagrams.

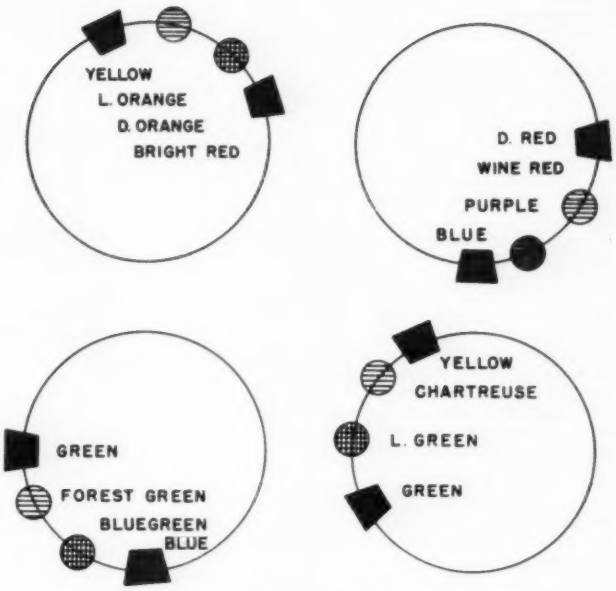

Fig. 3. Production of the thirteen ChromaCHron hues.

Top left: Mixtures of yellow and bright red produce light orange and deep orange. Formulas: 8 yellow plus 1 bright red = light orange. 8 yellow plus 7 bright red = deep orange.

Bottom left: Mixtures of blue and green produce bluegreen and forest green. Formulas: 5 blue plus 2 green = bluegreen. 5 blue plus 6 green = forest green.

Top right: Mixtures of deep red and blue produce wine red and purple. Formulas: 3 deep red plus 1 blue = wine red. 1 deep red plus 1 blue = purple.

Bottom right: Mixtures of yellow and green produce light green and chartreuse. Formulas: 6 yellow plus 4 green = light green. 16 yellow plus 1 green = chartreuse.

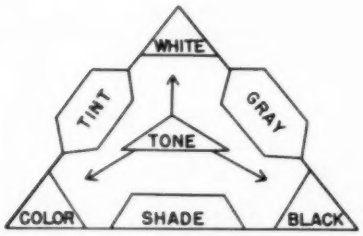

Fig. 4. Desaturation of color.
Color plus black = shade.
Color plus white = tint.
Color plus black and white = tone.

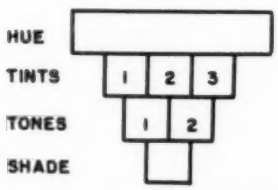

Fig. 5. Position of tints, tones and shade.
Formulas: 15 hue plus 1 black = shade. 20 hue plus 15 white plus 1 black = Tone 1. 10 hue plus 5 white plus 1 black = Tone 2. 1 hue plus 5 white = Tint 1. 1 hue plus 1 white = Tint 2. 5 hue plus 1 white = Tint 3.

Value refers to the gray scale equivalent of hue, tint, tone, or shade. Value of a color or color mixtures corresponds to its equivalent reflectance or to its position in the gray scale.

In common terms, tint is pale color, tone is grayed color, hue is vivid color, and shade is deep color, and the value of these is their gray scale equivalent.

In ChromaCHron each hue has three tints, two tones, and one shade. This gives each color seven variations, or there is a total of 91 color mixtures in the palette. Each color appears in the master palette as shown in Fig. 5.

Application of the System

ChromaCHron does not teach the artist how to paint. Color choice is a personal thing to be left entirely to the artist. ChromaCHron cannot tell him if his color selection is in good or in bad taste. It will only tell him that the colors will telecast with adequate gray scale contrast. If he selects colors without the aid of a ChromaCHron chart, it is possible that the results will be acceptable. However, by checking the ChromaCHron chart, he is assured that his color choice will work. The artist compares his color selection to the ChromaCHron colors. This helps him visualize the gray equivalents. The art can then be produced without doubts and with greater confidence. Depending on how his art will be reproduced — film or live — he uses the appropriate equivalents.

Although the brightest and darkest paints are well within the brackets of safety, the 20-to-1 ratio can be exceeded. This ratio is dependent on the mode of lighting, the variety of lighting, or the presence of a specular light source in the picture. In general, to maintain the 20-to-1 relationship, one should determine the lighting contrast on the set and divide this figure into twenty. This gives the number of grays that can safely be used. With a 2-to-1 lighting ratio, the range is limited to ten grays. When persons of average complexion are in the picture, it is advisable to stay in the middle range of the gray scale, which is gray #5 through gray #15. In motion-picture film the light ratio can be 30-to-1. The number of grays used must be determined accordingly.

Under flat lighting conditions it is impossible to exceed the system's limitations when painting with ChromaCHron, whether it be live or film.

Color art for live television, whether originating in color or in black-and-white, is aided by ChromaCHron. Stations not telecasting in color may use it to improve the gray scale of their present artwork. It also starts a library of color artwork for the time when color equipment is installed. Color films can be produced by knowing the approximate gray equivalents of the colors when telecast in color. The equivalents also permit of determining when a black-and-white motion-picture print should be made of the film.

Discussion

Anon: Having in mind that the system is based on a 300 ft-c base light or reference level and a common or identical background, is it possible that something more could be accomplished with a scenic designer?

Mr. Wagner: A system such as you suggest was studied several years ago, but we found it impossible to determine accurately what the gray scale would be in each instance because of difference in lighting levels and reflecting surfaces. Such a method seems workable only if it can be based on three levels of lighting: low, medium and high keys; and then if it could be adapted to different materials on which the color might be placed, such as a matte surface, duvetyn, high-gloss surface, etc.

In respect to the problem of an extremely glossy surface in the picture, our paints are not glossy and it's my feeling that if you're going to use a glossy surface on the set you're asking for trouble. When this system was first developed (and we're still working on it, doing research on textiles and different types of card stocks) we found that it was limited to a certain type of lighting and set construction which conforms to the procedures followed by most small stations. Our main interest is in solving the problems of the smaller stations.

John Koushouris (CBS Television): I take it that you have reference to certain types of paint used by your station in the manufacture of sets.

Mr. Wagner: That is correct. We do not manufacture these paints. They are made for us and will be commercially available within a few months to persons who wish to have them along with the ChromaCHron palette.

Stanley Marks (National Chemical and Mfg. Co.): You mentioned in your talk that these paints are water-thinned. Is there a particular reason for this?

Mr. Wagner: Yes, they are suitable for graphic art and serve to reduce fire hazard in scenery. Oil paints are not suitable for graphic art.

Mr. Marks: Would you use a poster paint?

Mr. Wagner: The Luminall fresco colors which we use are suitable for both scenic and graphic. There is no reason to get a paint that serves only one purpose when a more versatile paint is available.

Mr. Marks: Would you say then that the opaqueness and also the flatness of the flat effect that you get with that type of material constitute a definite factor in ChromaCHron?

Mr. Wagner: Definitely; for ChromaCHron, it must be opaque and it must be flat.

John B. Chatten (Philco Corp.): I noticed in the palette that most of what we term saturating colors, that is, the most vivid colors, are not as vivid as we believe the color system capable of reproducing. Color shows on the network seem to have scenes tending to be pastel rather than vivid. If this is intentional, what is the reason?

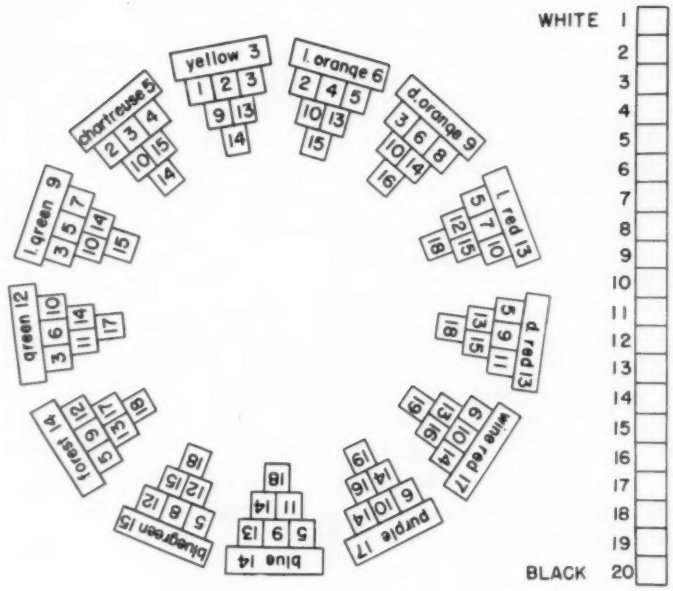

Fig. 6. Live television equivalents. The value of each color is designated by its number which corresponds to a gray-scale value.

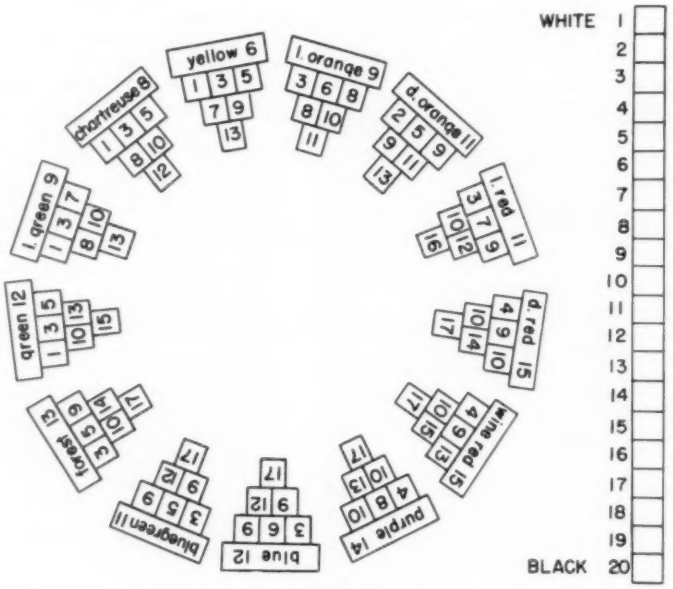

Fig. 7. Gray equivalents; photographed with Eastman Color Negative Film, Type 5248, printed on Eastman Color Print Film, Type 5382.

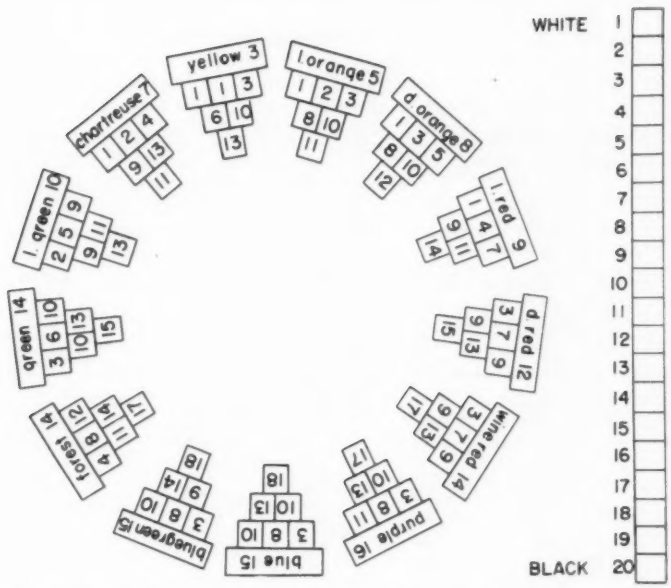

Fig. 8. Gray equivalents; photographed with Eastman Color Negative Film, Type 5248 and printed on Eastman Panchromatic Separation Film, Type 5235.

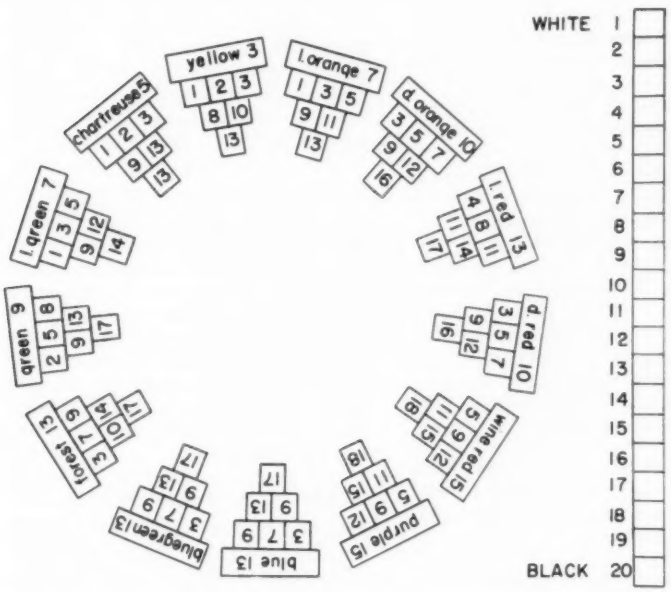

Fig. 9. Gray equivalents; photographed with Anscochrome 35mm motion-picture film.

Mr. Wagner: A particular color cannot be considered apart from its surrounding or environment. In other words, a color is what it is in all its particularity, at a given moment, in a given setting, because of its surrounding or environment. A color scene in a picture where there are many colors cannot be vivid. For example, in the ChromaCHron palette there is a color called deep red — a sort of magenta. Actually, it is not magenta. Displayed on a gray surface it is closer to a wine color. You want the magenta really to stand out, and you use the term "pastel shade." Then you are not asking for saturation but for luminosity.

Engineers and artists are different and they have different vocabularies. The artist says: yellow, turquoise, and magenta. The engineer says: minus blue, minus red, minus green. Artists know that by diluting a color, or we'll say, by making a tint out of it, you have "luminosity." The lighter the color, the more "luminous" it is. Because all three guns are producing this color you are bound to get brightness or luminosity. A fully saturated pigment may look awful on the system because of the low percentage of light used to produce it. Dilute it — make it a tint — make it a so-called pastel shade — and it has sparkle. Surround it by its complements, or surround it by something dark — and you've got the most "vivid" color you'd ever want to see. In reality it isn't vivid; it merely appears to be.

Anon: Have you noticed any difference in the appearance or in the gray scale of your colors when you use light sources other than 3200 K.

Mr. Wagner: We have tested only 3200 K. We planned to test 3400 and more, but our time was limited. We had to verify each step and make certain that, for example, if we say "light red" tint 2 is equal to grade 7, that statement is accurate. Our main problem is to make sure of enough contrast between two adjacent colors.

Anon: The thing that interests me is that most 3200 K lamps are designed to be at about 3250 K initially and depreciate to about 3150 K. They are actually at 3200 K for only a brief instant during the life of the lamp. I wonder if the normal color shift among lamps of different ages will be enough to upset the color pattern.

Mr Wagner: Apparently not. I said that these films were shot at *f*/2.5 at 1/50 sec, but in addition we shot at different speeds and allowed the lamps to burn for varying periods of time. We found that any variation in the gray scale was negligible. The importance of a gray depends upon what is next to it. If you have two grays with adequate color contrast, you've got it made!

Anon: From our experience there would be little effect, even on color, within a range of plus or minus 100 K.

Mr. Wagner: We didn't notice too much change in color between lamps that had just been turned on and lamps that burned for some time.

Film in Television

By RODGER J. ROSS

Much of the film currently being supplied for television purposes is of poor quality. This problem is discussed and factors contributing to this unsatisfactory situation are considered. Some remedial practices are suggested.

MOTION-PICTURE film has assumed a major role in television programming. Many of the more important programs on film are in direct competition with live studio originations. Unfortunately, the quality of much of the film currently being produced for telecasting is very poor. Broadcasting agencies are becoming increasingly concerned about the low quality of film picture and sound.

Attempts to adapt conventional motion-picture processes and techniques to meet the requirements of television have failed to provide satisfactory solutions for the problems facing motion-picture and television groups. From the standpoint of the broadcaster, the objective in telecasting film is to generate video and audio signals technically equivalent to live television pickups. In order to produce film images with the desired characteristics, the proper starting point is the telecine reproducer, working backwards through the film process to the taking camera. The film system may then be considered as an extension of the television transmission system, and by taking advantage of the inherent reproducibility of the film process, it should be possible to generate predictable video waveforms. At the same time, advantage may also be taken of the flat film sound reproducing systems established by the television industry to produce tracks with predictable response characteristics.

These observations are offered as a result of close association with a network telecasting operation over a period of several years, during which significant advances have been made in the use of film in television. For example, film is no longer considered as "fill" to bridge gaps in live broadcasting schedules, and it has been demonstrated that film can be produced well suited for telecine reproduction.

Television and 16mm Film

The television industry in North America adopted the 16mm film size in the early stages of development, mainly for economic reasons and also to avoid the severe regulations governing the handling of 35mm nitrate materials.

Up to that time, 16mm film was generally considered to be substandard, unsuited for serious professional use. While a few 35mm telecine and recording installations have been set up by the major networks in the United States, the television industry is primarily a 16mm film user and exhibitor; and it is unlikely that this situation will change significantly in the foreseeable future.

It should be noted, however, that the British Broadcasting Corp. is by no means convinced that the 16mm film size is the best compromise. H. F. Chapman, Planning and Installation Dept., BBC, has stated:[1]

"The view is put forward that 16mm cannot at present, provide the quality desirable for all television film purposes, and it is essential to retain 35mm for a certain percentage of program work if quality standards are to be maintained. It is difficult to predict whether 16mm film will eventually improve to an extent which will enable it to be used for all purposes. A recent survey of continental operations showed that whilst 16mm is used exclusively, opinions concerning the correctness of this policy are divided. Some believe that it is the correct size and that eventually it can be developed to be equal to, if not better than live television. If the full potentialities of 16mm film in TV are to be realized, it is essential that a new professional approach to this gauge is made in every branch, stock manufacture, equipment, processing and equally important, handling."

At one point in his paper, Mr. Chapman makes particular reference to the unreliability of commercial 16mm processing.

Protests About Poor Film Quality

This is by no means the first time that complaints of a similar nature have been made. At a meeting of the SMPTE Television Committee during the Spring 1957 Convention of the Society in Washington, D.C., a letter from Carl Wiegold, Film Director, WSJS-TV, Winston-Salem, N.C., was read, containing among others, the following comments:[2]

"I am anxious to know what progress is being made towards establishment of 16mm film practices and equipment standards for the TV broadcast industry. My own experience in daily commercial broadcast film operations, indicates that there is a most urgent need for concerted action within the industry towards substantial improvement in this area of operation. It is also apparent that the adoption of standards, insofar as practicable, specifically determined and formulated for the TV industry, would materially help in effecting this improvement.

"Although it should, by now, be pretty generally known that the film practices and equipment requirements of the TV industry are, for the most part, peculiar to this industry alone, there are as yet film, camera, projector and equipment manufacturers, together with a host of film producing and processing laboratories, that are apparently completely ignorant of the requirements of this industry, and that these requirements differ markedly from those that have long been accepted as standard for general exhibition use.

"There seems to be a large variation of disagreement among film producing and processing laboratories concerning the specific requirements of this industry, particularly regarding the production and processing of 16mm prints. There seems to be an almost universal ignorance at the laboratories of sound levels, signal-to-noise ratio and distortion of any variety."

This may seem to be very harsh criticism of the motion-picture industry. But Mr. Wiegold, as a film director of a commercial television station, is not alone in protesting about poor film. At a meeting of the Association of Cinema Laboratories which took place during the same Convention, Marshall Rotham of Kenyon and Eckert, Inc., made the plea that the motion-picture industry should try to do something in the direction of improving quality of TV film.

Film Evaluation in Telecine Areas

In Toronto, the major programming center for the English language network of the Canadian Broadcasting Corp., the supervisors responsible for the telecine projection service estimate that no more than 10% of the film supplied for telecasting can be classified as first-class quality, that is, very nearly equivalent to live studio origination; 40% is mediocre and the remaining 50% should be rejected.

Two or three years ago, scarcely anyone associated with TV broadcasting expected very much in the way of satisfactory video and audio signals from film. This situation has changed. A number of syndicated telefilms now arrive regularly in the telecine rooms of broadcasting stations with consistently high-quality picture and sound. The question

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naturally arises, what is wrong with the remaining 90%?

Unfortunately, there appears to be very little that television technical groups can do about poor film. When it is discovered during rehearsal, a few hours before scheduled broadcast time, that the picture or sound is unsatisfactory, all that can be done is to make a strong protest. But to whom can the protest be made, when the source of the film is usually unknown? If the film is commercially sponsored, the complaint may eventually reach the producer or the laboratory, through the agency representative. Very little can be done about the imminent telecasting of the offending film. The program is scheduled for broadcast, thousands of viewers may have their sets turned on waiting to see it, and costly advertising campaigns may have been built up around it through the entire country served by a network. Inevitably, TV technical groups have very little hope of preventing the release of low-grade film on air.

The universal answer to protests about poor film is that there is no time to replace it and, even if another print could be obtained in time, the negative may have been defective in the first place. It is unlikely, at the present time, that anyone is going to make a new negative because of protests from a TV broadcaster.

Will Better Planning Produce Better Film?

It would appear that better planning further in advance of the program release date is indicated, but well-prepared plans do not always produce the desired results. On one occasion, following the telecast of a film program an advertising agency despatched its representatives to the local TV station to find out why the sound in their commercial inserts was received by viewers at a much lower level than the program proper. It was suggested that the broadcasters were at fault, and that something should have been done to enable viewers to hear the sponsor's messages.

When the film in question was screened on a projector, it was discovered that it consisted of ten sections spliced together to make up a half-hour package. The film program proper was obviously a product of a Hollywood company, and six short commercial inserts had been incorporated into it. Three of these had been made in the United States and were spliced into the film program when it arrived in this country. Just prior to its release, the three remaining inserts, produced some time previously in Canada, were added. During the screening severe variations in sound level occurred between the film program proper, and the commercial inserts.

The broadcasters disclaimed responsibility for the defective audio in this case. It was admitted that adjustments of the audio gain control could be made to compensate, at least partially, for variations in level on the film at the expense of increased noise, but as the commercial inserts were only thirty seconds to one minute in length, it would be very difficult for the audio operator to make the required amount of gain adjustment. In addition, the agency would have to depend upon the audio operators to make the correct adjustments in each station where the film was scheduled for release, and these level changes could be made only while the sound was being broadcast.

It was suggested to the agency representatives that they should go back to the laboratories where the different sections of the film program were made and request balancing of the audio levels.

The question was then asked: "How can we tell them the sound level that we want? Work on the Canadian commercial inserts must be started long before the film program arrives from the United States. Then there is also the problem of variations in level between the program proper and the commercials spliced in before the film arrives in this country. Surely, with the amount of film being used in television, there must be some way to overcome this problem."

Responsibilities of Television Groups

This incident is a typical example of the difficulties with which television engineering groups are faced in transmitting acceptable sound and pictures. What can they say to people who complain, often loudly and bitterly, about poor quality? It is becoming increasingly difficult to shrug the shoulders and say: "But that is not our problem."

Perhaps the time has come for TV engineering groups to take positive action and undertake the task of tracking down the causes of poor pictures and sound. This can be a very complex and frustrating undertaking. In one case not long ago, an agency representative advised that commercial film inserts are produced for his company in 22 different laboratories in Canada, the United States and Europe. That investigation had to be dropped because there was no means of determining which one of these laboratories produced the offending piece of film.

Telecine System Setup

There appears to be a widespread notion that the broadcasters are responsible for much of the faulty reproduction from film. In May 1957, the Rochester Section of the Society held a symposium on film process control. During the discussion period, a member of the audience asked this question: "Why is it that two TV stations broadcasting my film will produce pictures that appear to be quite different?" It is, of course, physically impossible to observe the same film on two stations simultaneously in order to make the kind of comparison suggested by the questioner. He had probably seen the same film or two prints from the same negative on two different stations at different times, perhaps on different receivers, or at least on a receiver which may not have been adjusted in exactly the same way for each viewing. He was undoubtedly earnestly trying to make a careful comparison, so it was assumed that these factors had been taken into account and that a difference in transmissions had actually occurred.

The question was answered by explaining that broadcasters are unable, because of large variations occurring regularly in film supplied to them, to maintain standard reproducer setups. The Society produces a test film used by TV stations to align telecine equipment. When the equipment is correctly adjusted, representative scenes at the end of the test film will be reproduced in a satisfactory manner with no further adjustment of the controls. In the present state of the art it is almost certain that the first piece of film to be telecast at the start of the day's operation will require some readjustment of the controls in order to transmit a video signal meeting stringent broadcasting requirements, or to produce what appears to the operator to be the best possible picture under the circumstances. Because it is presently impossible to maintain an equipment setup based upon the use of test material, it is also impossible to reproduce the same film twice, with identical picture appearances.

Anyone who has had the opportunity of observing a telecine operation may have noticed that the video operator instinctively reaches for the controls as soon as the projector is started so as to be ready to make what may very well be major readjustments in an attempt to compensate for variations in the film. Broadcasters are forced to do what they can to salvage film programs. Their task would be greatly simplified, and much better and more consistent picture quality could be assured, if all film were correctly made in the first place.

Variations in Film Densities

At the Spring 1957 Convention of the Society in Washington a paper[3] was presented on a self-adjusting video amplifier for use with telecine camera chains, to alleviate the problems encountered in this area of operation. It was stated that this amplifier had been designed to accommodate variations in film transmission of the order of 10:1. When a member of the audience asked in the question period of a related paper,[4] why such a large factor had been allowed in the design, the discussion brought out that investigations at operating points

indicated variations in the lighter areas of film images between 85% and 2%.

This is equivalent to a variation in minimum density of 0.06 to 1.70. It is indeed strange that film is still being produced with a highlight density very nearly as great, in extreme cases, as the shadow density currently recommended for television use, and that broadcasters and designers of reproducing equipment are still expected to cope with variations of this order. In fact, it is difficult to understand how film with a minimum density of 1.70 could be used for any purpose.

Waveforms vs. Subjective Picture Quality

It is a mistake to assume that film which produces an acceptable subjective response on a projection screen will reproduce satisfactorily in the TV system, and to blame the video operator if it does not do so. The primary responsibility of the operator is to transmit a video signal in conformity with established broadcasting standards, as observed on a waveform monitor. If the film will not generate a satisfactory waveform, it is the duty of the operator to adjust the camera controls to satisfy this condition as closely as possible; however, a video signal suitable for transmission is not necessarily synonymous with subjectively acceptable picture images.

In broadcasting operations, the primary engineering objective is to set up and maintain transmission systems with carefully specified characteristics evaluated regularly by means of reference signals. It is recognized that as broadcasters have no control over the types of receivers which are used, or the manner in which these devices are operated, their responsibility is limited to maintaining transmission systems in accordance with standards recognized by the industry. These standards are set up in such a way that, when a transmission system correctly reproduces the appropriate test signals, program information will be reproduced on high-quality, correctly adjusted receivers, with no significant alteration or degradation within the limitations of the system.

Generation of Waveforms by Film

All electronic systems have inherent or practical limitations. The picture portion of the video signal commences at black level and increases in voltage amplitude to peak white. Within these two outer limits all picture information — the tonal scale — must be fitted. The system is not capable of handling a contrast range greater than approximately 30:1 without distortion. Distortion, due to contrast ratios greater than this limit, becomes apparent in reproduced pictures as compression in either blacks, or whites, or both. In motion-picture terminology, this type of distortion is described as a loss of detail in shadows or highlights.

When film is placed on a correctly adjusted telecine chain, the transmission of light to the camera tube by the various areas of the images should be such that a signal at black level is generated by the darker areas in the film, and, at the opposite end of the scale, peak white voltages should be generated by the picture highlights. The video signal will then fill the graticule of the waveform monitor. If the contrast of the images is too great, the video signal must be squeezed down to fit the graticule. If the contrast is too low, the signal must be stretched. This squeezing or stretching is necessary to modulate correctly the transmitter, but serious degradation of picture appearance may result.

Distortion of Picture Tonal Scale

In conventional motion-picture operations attention is mainly directed toward correct reproduction of areas of primary interest, such as faces, in relation to black and white on the screen. On the video waveform monitor it is very difficult to relate voltage traces to specific pieces of picture information. If a face occupies the lightest area in the frame, as is often the case in film supposedly made for television, the visual result is usually disastrous if the video operator attempts to raise the amplitude of this portion of the signal to peak white. Because, in the present situation, great variations are encountered in film, the video operator must be allowed to exercise considerable discretion to avoid excessive degradation of picture information. He must decide very quickly, when he is confronted with a change in the signal characteristics, whether he should transmit an improperly modulated signal to avoid picture degradation, or risk poorer pictures in conforming with waveform requirements.

Responsibilities of Video Operators

It is perhaps not generally recognized that the decision of a video operator in situations of this kind may have far reaching consequences. In a network operation, under-modulation of the signal may adversely affect the quality of pictures on many receivers, particularly in fringe areas. At the same time, the signal output is subject to close scrutiny by Master Control and at various network monitoring points, and failure to conform to waveform requirements will be quickly brought to the attention of the operator at the originating point.

It is, of course, not possible to maintain 100% amplitude in the video signal at all times, disregarding the program material which is being reproduced. This would be equivalent to stretching all pictures to white or putting white in pictures whether or not this was intended in the first place. However, the video operator cannot determine, except superficially, whether the maximum amplitude generated by the film is low because the producer of the film intended the pictures to be dark, or if the low highlight transmission of the images is due to errors or bad judgment in the manufacture of the film. No one, including the video operator, wants to become involved in the interpretation of picture characteristics. It is a situation into which broadcasters are forced by failure of film makers to produce images which will generate satisfactory waveforms.

Reference Picture Black and White

Some producers of TV film have already recognized that it is necessary to introduce deliberately into every scene areas of maximum black and white, which will generate black level and peak white voltages in telecine reproduction. In the telecasting of films made in this way the video operator quickly recognizes that only minor adjustments are required to maintain satisfactory waveforms from scene to scene. Faces and other areas of primary interest, as well as the general tone or mood of the pictures, will be correctly reproduced according to the intent of the producer.

Responsibilities of Film Groups

Complaints are frequently made that TV engineering groups are unwilling, or unable, to make positive statements on the requirements of TV film. This is by no means the case. To be quite frank, the basic cause of difficulty is that many people in the film industry are reluctant to find out for themselves what has to be done to produce film which meets TV requirements. Television groups are unwilling, and understandably so, to offer specific advice to film groups, mainly because with a limited knowledge of the film process electronics specialists are unable to make practical suggestions. Television groups naturally look to the film industry to deliver a product that is suitable for TV reproduction. A properly adjusted telecine reproducer might be considered as a type of simultaneous transmission meter, by means of which film images may be readily analyzed in reference to test material with known characteristics. It would appear that advantage might be taken of this feature in adjusting the film process to meet TV requirements, rather than attempting to measure the density of small areas in 16mm film images.

Deficiencies of Film Soundtracks

Television broadcasters have discovered that a film sound track said to be "good" will not necessarily give rise to a faithful reproduction of the original sound. The deliberately restricted frequency response characteristic agreed upon many years ago for the theater has influenced 16mm film production with

the additional disadvantage that much less care seems to be taken generally in making 16mm soundtracks. The lack of standardized listening conditions obviously has not induced 16mm film producers to approach the problem in the same way as broadcasters, who are faced with similar difficulties — namely to establish systems with known frequency response, signal-to-noise ratio and distortion. In fact, the published literature fails to indicate that a thorough study has been made to determine the maximum response which can be achieved with film.

The present situation can be summed up in a few words: the greater part of the film sound supplied for transmission over FM sound systems definitely falls in the low-fidelity category.

It is suggested that the time has come to re-examine this area of film operations. Can we continue to insist that a film track which reproduces satisfactorily in a specially constructed review room should be acceptable to the public as it is reproduced by TV receivers? Have we made a really serious attempt to utilize the maximum capacity of 16mm film systems to reproduce sound signals? It is scarcely necessary to point out that TV broadcasting provides the opportunity to evaluate, or to put it another way, subject listeners to the output of a thousand film industry review rooms.

It has been said by some authorities in the film industry that it is impossible to reproduce sound faithfully with 16mm film, that the best that can be done is to restrict the reproduction with the object of conveying maximum intelligence. Now this approach may be acceptable in making films for exhibition on shipboard or in a schoolroom in the presence of a noisy, low-grade projector, but it is not acceptable when film is broadcast as a part of a high-quality musical program. John Maurer recently put it this way,[5] "The trouble is that the experience of poor performance leads to the impression that really good performance is impossible."

Improvements in Film Sound Reproducers

When the Eastman Model 25 Projector was announced in March 1950, Edwin C. Fritts made the following statements[6]: "It is well known that the reproduction characteristics of commercially produced 16mm films vary over a wide range. In the absence of precision projection equipment, it has been difficult to demonstrate the ultimate quality of either picture or sound. This projector is designed for best reproduction of films made according to the most advanced production practice. At the same time, it is necessary to handle the full range of quality encountered in films coming from current production. Added to this is the problem of the great variation in listening conditions encountered in 16mm operation."

Standardization of Sound Reproducing Characteristic

Subsequently, the tone control on the Model 25 projector was eliminated when it was incorporated into a telecine camera chain designed by the General Electric Co. for film broadcast purposes. The instruction manual states: "The output of the first amplifier stage goes through a selector switch which has three positions. One position gives a flat response from the SMPTE multifrequency film Z22.44 from 50 to 6,000 cycles. The other two positions give variation in roll-off at the high end to compensate for film noise and dirt. Normal operation is in the flat or No. 1 position."

It should be noted that this response characteristic was proposed by Dr. Fritts in a paper presented at the Spring 1951 Convention of the Society.[7]

The elimination of tone controls and the decision to operate TV film sound reproducers with a flat frequency response characteristic represented a significant turning point for the 16mm film industry. For the first time, the industry was provided with a standardized sound reproducing condition. Unfortunately, there is little evidence to indicate that the industry has taken advantage of this important development.

In its use of 16mm film for recording of television programs, the Canadian Broadcasting Corp. has for the past four years successfully operated a flat sound recording and reproducing system. Broadcasters, however, are not entirely satisfied with the best film sound produced so far. It might be reasonable to expect that concerted efforts in the direction of further improvement may well put within practical reach, the minimum specification of EIA Audio Standard TR 105B, except for the high frequency roll-off characteristic.

Fault Reporting Procedures

In the broadcasting industry, well-organized fault reporting procedures are employed to trace faults to their source and there institute corrective measures. Thus, transmission systems with specified characteristics may be set up and operated by ensuring that each element in a system functions in a specified manner. If, for instance, the signals at the transmitter are found to be defective in any way, the operator at this point is not permitted to take corrective action by misadjusting his equipment; his responsibility is to ensure that his equipment is not introducing the fault, and then to report the defect to the preceding link in the chain. This checking process is repeated until the cause is located and corrected.

In contrast, broadcasters find that it is extremely difficult, and often impossible to trace film faults to their source. Film arriving in telecine rooms is in fact almost completely anonymous. The film industry does not appear to recognize the necessity for identification of film sources. Thus, the tracing of defective film becomes a laborious and time consuming procedure. To make matters worse, there has been as yet no general tendency towards the standardization of the film process, and at each stage some form or degree of corrective action is frequently taken in attempts to compensate for errors in earlier stages or to obtain what appears to be a more satisfactory final product as observed in the review room.

A good example is the transfer of sound from magnetic film to optical track. Who should be charged with the fault if the sound reproduced on the telecine projector is defective? When the technician who makes the original pickup knows very well that at some later stage of transfer, some type or degree of correction or alteration is almost certain to be applied, he can scarcely be expected to make sure that everything is in perfect order for recording before this work is started, and so it goes all the way down to the release print.

Coding and Identification of Film

Coding or identification of film is only the starting point in correcting this situation. The main purpose of coding is to find out who handled the film and the machines on which it was run. Then it is necessary to devise appropriate test procedures to establish normal operating conditions at each stage of the film process and methods for detecting deviations from these conditions.

These are by no means revolutionary ideas. Modern industry makes extensive use of the principles and practices of statistical process control. The practice of branding and coding products provides protection for the reputable manufacturer as well as for the user. It is not suggested that the film industry deliberately seeks anonymity to avoid disclosure of the source and cause of poor film. It seems to be a habit within the industry, a habit that has been carried over into TV film operations.

Standardization of the Film Process

Due to the increasing concern on the part of broadcasters regarding the quality of TV film, aggressive action by the film industry is required to improve the present unsatisfactory situation. About a year ago, the Canadian motion-picture laboratory practices standardization committee was organized as a step in this direction, in an attempt to deal with one important phase of the problem. This group, with wide representation across the country, has become a Society Subcommittee and has undertaken as its

first task the standardization of sensitometers and densitometers, the measuring tools, in participating laboratories.

The Future — A Challenge

The successful utilization of film in television is a challenging enterprise. Motion picture and television groups have a common goal — and a very rewarding one — to broadcast film technically equivalent in sound and picture quality to live studio originations. When this objective can be achieved consistently, decisions to use the film process or a TV camera can be based sensibly on practical considerations of economy or convenience.

Some people dream of the day when an ever more intimate joining of the television and motion-picture systems will produce programs on film electronically. At the present rate of progress it is almost certain that within a few years, we will be doing things in an entirely different manner than we are today. We may some day be able to look back on the present restless, and often unhappy, marriage of film and television in much the same way as we now recall the advent of the horseless carriage.

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A Look at the Motion-Picture Projector as an Integral Optical-Mechanical System

By HAROLD E. ROSENBERGER

Optimum performance from the motion-picture projector requires that it be designed as an integral optical-mechanical system. Using one component of the projector as an example, the first part of this paper illustrates the fact that specifications for the individual components cannot be arbitrarily assigned without regard to the other components of the system and that an improvement in any one aspect of performance may be accompanied by a degradation in some other aspect. A suggestion is made as to how improvement in motion-picture projection equipment can be attained through the cooperative action of equipment manufacturers and the professional societies.

The second part of the paper is a description of each of the optical components of present-day projectors aimed at answering some of the questions which are continually being asked of the optical manufacturer, thereby presenting an insight into the many factors which the optical designer must consider and why an integral design is so essential for optimum performance.

With the motion-picture projector as the one notable exception, optical instruments are conceived, designed and manufactured as integral optical-mechanical systems under the control and supervision of one prime manufacturer. Under this system, the manufacturer has complete control over his product and is in a position to establish the compromises among the individual components which will result in the best overall performance of his instrument. Even though many of the components might be purchases from other suppliers, the prime manufacturer controls their design through his specifications and assumes the responsibility for their performance in his finished product.

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From the point of view of the customer, the advantages of this method of manufacturing are self-evident. The potential purchaser of a telescope, for example, does not have to inquire about the speeds, or focal lengths, or field coverages of the many optical components which go into the modern telescope. Since he is concerned only with the performance specifications of the complete assembly, he can fairly painlessly make his choice among the products of the various manufacturers.

The task confronting the potential purchaser of motion-picture projection equipment is not so simple, for he is a victim of the exception to the rule we referred to in the beginning.

From the point of view of realizing the best in overall performance, the motion-picture projector most certainly should be considered as an integral optical and mechanical system. In practice it more aptly fits the description of being a collection of optical and mechanical parts. The problem of selecting and assembling the components (designing the projection system is probably more fitting) with the aim of securing the best overall performance is a burden which falls on the projection people.

To the parts manufacturer, this practice is both an advantage and a disadvantage. It is an advantage because to a large extent it relieves him of responsibility for the performance of his product. It also provides him an easy opportunity to exploit as a sales gimmick some feature of his product which, though desirable, cannot be utilized because of limitations imposed by other components of the system. The conscientious manufacturer, on the other hand, finds himself at a disadvantage since his refusal to join the "battle of numbers" costs him sales.

PROJECTION EQUIPMENT REQUIREMENTS

The purpose of this paper is twofold. The first objective is to suggest to the projectionist that he take steps through his professional societies to relieve himself of the problem he now faces in choosing projection equipment. To illustrate the need for centralized research into the requirements of projection equipment, let us consider just one component of the projection equipment, the projection lens.

In line with the current demand for more and more screen illumination, the idea of using faster projection lenses certainly is an attractive one — at first glance, at least. But putting this idea into practice introduces a host of new problems. Let us consider just a few.

(1) *Resolution performance.* Because the higher-speed lens is inherently more difficult to correct in the design stage and more difficult to produce in the manufacturing stage, a general lowering of resolution performance is to be expected of higher-speed lenses.

(2) *Image contrast.* Like resolution performance, image contrast can be expected to deteriorate. Getting more light through the higher-speed lens is one thing, but being able to design and manufacture the lens so that the added light is properly directed is something else. Unless the added light is properly directed, we might just as well increase screen illumination by turning on the theater lights.

(3) *Uniformity of screen illumination.* Uniformity of illumination over the projected picture area is dependent upon the total vignetting which occurs both in the projection lens and in the illumination system. Increasing the speed of the projection lens alone will not produce a uniform increase in illumination over the whole picture area. To accomplish a uniform increase may require a change in the illumination system which the manufacturer is unable to make. We shall consider this problem more thoroughly further along.

(4) *Depth of focus.* We shall use the term depth of focus in its usually accepted sense of being the distance along the lens axis through which an object can be moved forward or backward without causing a detectable change in focus of the image of that object. Its practical importance is that it is indicative of how much film flutter or buckling can be tolerated in a given projection system. The formula for computing the depth of focus of a lens is, by the Raleigh criterion,

$$\text{Depth of Focus} = \pm \frac{\lambda}{2 \sin^2 u'},$$

where λ is the wavelength of light and, as usual, taken as 5.50×10^{-4} mm $= 2.17 \times 10^{-5}$ in. and u' is the angle which the emerging marginal ray makes with the lens axis. Also,

$$f/\text{number} = \frac{f'}{A}$$

where f' is the lens focal length and A is the diameter of the entrance pupil. Finally,

$$f' = \frac{A}{\sin u'},$$

which is the fundamental definition for lens focal length. Combining these three equations yields the relationship:

$$\text{Depth of Focus} = \pm 0.000043 \times (f/\text{number})^2 \text{ in.}$$

For comparison purpose, we list the depth of focus for several lens f/numbers.

f/Number	± *Depth of Focus, in.*
2.5	0.00027
2.0	0.00017
1.8	0.00014
1.6	0.00011
1.4	0.000084

We note that going from $f/2.5$ to $f/1.8$ effectively cuts the depth of focus in half, and that at $f/1.6$ the depth of focus is reduced to just about five wavelengths of light.

(5) *Alignment of the projection lens with the film plane.* It follows that as the depth of focus decreases with increased projection-lens speed, the alignment of the optical axis of the projection lens perpendicular to the plane of the film gate becomes increasingly critical.

(6) *Speed of the illumination system.* This, too, becomes more complex with increasing projection-lens speeds as will be illustrated further along.

These are but a few of the many factors which it must be recognized influence overall performance and which are affected by the choice of the projection-lens speed. Considering the fact that the projection lens is but one component of the projection system, it is quite apparent that a list of all the known factors of all the components contributing to the overall performance will be quite an imposing one. Moreover, it is quite apparent that the interdependence of the performance of one component upon the performance of one or more of the other components necessitates the evaluation of each component with respect to its performance in the system, rather than its performance as an entity.

With these problems in mind, how shall the projectionist make his choice? We have said, for example, that we can increase screen brightness at the expense of image contrast, but what should the compromise be? The same question applies to brightness and resolution. We have shown that depth of focus decreases with increased lens speeds. From experience we know that we cannot, nor do we have to, focus the projection lens to quite the precision indicated by the theoretical values, but we do not know at what point depth of focus does become the limiting factor in image quality. We know that we can change the brightness distribution on the screen by varying the speed of the illumination system; but do we know what the relationship should be between the projection-lens speed and the illumination-system speed from an overall consideration of brightness distribution, film buckling, cost and convenience of size of the lamphouse?

How can we get the answers to these problems? Certainly they will not come from the manufacturers involved because the manufacturers have little or no incentive to solve the problems. Piecemeal advances in projection equipment will, of course, continue to be made, as for example, the recent introduction of the cold mirror. But even in this case, maximum utilization of the cold mirrors requires certain changes in the lamphouse over which the cold-mirror manufacturer has no control.

It is the fact that the optimum designs for the various projection situations will require compromises in every component of the system that discourages the various manufacturers, *acting as individuals*, from finding the needed solutions. This is the reason why the suggestion was made that the projectionist, through his professional societies, conduct centralized research into these problems and establish specifications for the equipment which best suits his needs. In today's competitive market, the manufacturers will have no choice but to supply these needs.

ANALYSIS OF OPTICAL COMPONENTS

Our comments above concern the future. The second objective of this paper concerns the present, and by way of an analysis of the part played by each optical component, will attempt to answer some of the questions which are continually cropping up about projection optical equipment, starting with the projection lens.

Central Image Formation

What does a projection lens do in the projection system? How does it form the image we see on the screen? What are its limitations? We do not really need a lens at all to form an image on the screen as can be demonstrated by the well-known pinhole optical system shown in Fig. 1A. The pinhole optical system does precisely what we ask the projection lens to do in that it *establishes a relationship between the film and screen such that light from each point in the object on the film is directed to one exclusive point on the screen.*

Unfortunately, the pinhole optical system too severely limits the amount of image illumination for it to be often of practical use. We could double the light on the screen by adding a second pinhole in juxtaposition to the first, but at the expense of image sharpness, since the image formed by the second pinhole would not be in exact register with the first as shown in Fig. 1B. Increasing the diameter of the first pinhole is equivalent to adding many pinholes adjacent to the first. Each new pinhole will add a new image on the screen, thereby increasing screen illumination, but at the same time adding more dis-

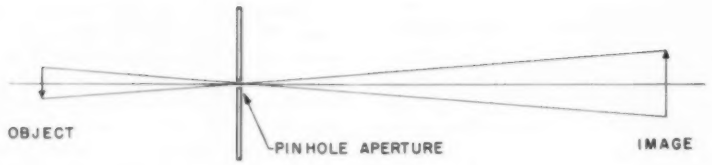

Fig. 1A. Pinhole optical system.

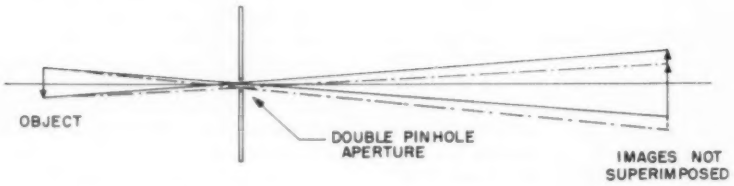

Fig. 1B. Double-pinhole optical system.

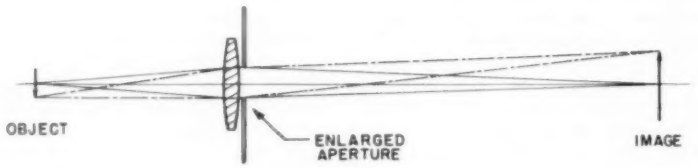

Fig. 1C. Simple-lens optical system.

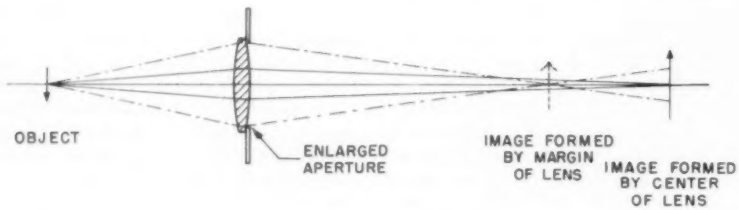

Fig. 1D. Spherical aberration of a simple-lens optical system.

cord to the image and making it unrecognizable.

We can retain the added screen brightness and regain image sharpness by inserting a simple lens in back of the now enlarged opening as shown in Fig. 1C. The very center of the lens acts just like the original single pinhole and defines the position on the screen where each point of the image should fall. In addition, light from any one point on the object which is incident on the lens above or below its center will be bent toward the light going through the center for that particular point on the object, and will intersect with this light in the plane of the screen. This, of course, adds to image brightness while retaining image sharpness. But if, again, we start enlarging the aperture, once again we begin to notice a softening of the image as its brightness is increased, due to the fact that the marginal regions of the lens do not converge the light rays to the same point on the lens axis as the central region of the lens, as illustrated in Fig. 1D. This effect is known as spherical aberration.

In addition, a new cause for image softness in the form of colored fringes in the image will be noticed. This effect is called chromatic aberration. Now there is nothing profound about these aberrations. They are simply characteristics of a simple lens in the same way that hardness, or weight, or light transmission is characteristic of the lens.

It was discovered many years ago that by combining two lenses, one positive, and one negative and made from dissimilar glasses, as illustrated in Fig. 1E, both the spherical and chromatic aberrations could be greatly reduced. The immediate result of this discovery was that once again the lens aperture could be opened up to give added image brightness without a sacrifice of image sharpness. While the importance of this discovery can hardly be overestimated it nevertheless was not an ultimate answer to increased lens speed, for the doublet, as it is called, also has a characteristic limitation of lens speed. Many investigators continued the search for improved designs. One of these designs which is still in use today is the well-known Petzval design in which four individual lens elements are combined to make up a single projection lens as shown in Fig. 1F.

Marginal-Region Image

Up to this point we have discussed only central image formation. What about the marginal regions of the image? A glance at Fig. 1F points up the serious difference in the relationship between the lens and its axial object and the lens and its off-axis object. In the first place, it is apparent that the off-axis object is located at a greater distance from the center of the lens than is the axial object. The effect of this is to cause the image of the off-axis object to fall closer to the lens than the axial image. This effect we call field curvature. Equally in evidence is the fact that the lens surfaces are not aligned symmetrically with respect to the off-axis object. This condition introduces additional aberrations, the names of which are unimportant, but the effect of which is a further degradation of off-axis image quality.

Types of Projection Lenses

Through the years, as the result of the work of a great many designers, a type of projection lens has evolved which, within limitations of field coverage and speed, reduces the many aberrations to a tolerable amount for motion-picture projection. This lens is called the Double-Gauss type and is shown in Fig. 1G. Depending on focal length, it is made up of six or seven separate lens elements. The Double-Gauss type is used by more manufacturers of high-quality projection lenses than any other type. For any given projection condition, it appears to represent the best that the present state of the art can produce. To be sure, the history of lens development indicates that the future will bring further improvement just as we have all recently witnessed in the introduction of CinemaScope.

CinemaScope projection is attained by the simple addition of the anamorphic attachment to the standard projection lens. That this can be accomplished with so little effort is indeed a remarkable technical achievement.

When an anamorphic attachment is combined with a projection lens, there results an entirely new kind of lens having properties quite different from either of its components. As we know, the magnification on the screen in the horizontal direction is different from that in the vertical. It follows, therefore, that the focal length of the combination of anamorphic plus projection lens in the horizontal is different from that in the vertical.

Now it is possible to construct a lens having different focal lengths in the two directions by the simple addition of a

cylindrical lens element in front of the projection lens as shown in Fig. 2A. But as shown in this figure, when we look at the combination from the side, the cylindrical component looks and acts optically like a slab of window glass, while from the top it looks and acts like an ordinary spherical lens. The result of this is that the combination has not only two focal lengths, but also two separated focal planes. Vertical structure on the film will be imaged in focus and horizontal structure out of focus at one focal plane, and the reverse at the other focal plane, but no focal plane will be found where all of the information on the film appears simultaneously in focus.

This intolerable condition is eliminated by the addition of a negative cylindrical lens element which, when made to the required focal length and properly positioned with respect to the positive element, pushes the near focal plane back to coincide with the far focal plane as shown in Fig. 2B. The addition of this negative element solves the focus problem, but does this combination give us a magnification in the top view different from that in the side view?

The proof that the difference in magnification has been attained can be found in our Fig. 2B. Before looking for the proof, we had best review the meaning of that elusive optical quantity called Lens Speed or Lens f/number. Customarily, projection lenses are rated for f/number, with respect to their object or film side, the f/number being numerically equal to the ratio of the film to lens or object distance divided by the free aperture of the lens. Now, the lens has an f/number rating for its image side just as well as for its object side, and this f/number numerically equals the lens-to-screen or lens-to-image distance divided by the same free aperture. Thus,

$$f/\text{Number (Image Side)} = \frac{\text{Image Distance}}{\text{Free Aperture}}$$

and

$$f/\text{Number (Object Side)} = \frac{\text{Object Distance}}{\text{Free Aperture}}$$

The relationship between the two f/numbers is therefore:

$$\frac{f/\text{Number (Image Side)}}{f/\text{Number (Object Side)}} = \frac{\text{Image Distance}}{\text{Object Distance}}$$

But since the ratio of image distance to object distance is equal to the magnification at which the lens is being used, f/number (Image Side) = f/number (Object Side) × Magnification.

It is a common experience for us that, for a given projection throw, we can increase image magnification on the screen by a reduction in focal length but that even though the rated speed of the shorter-focal-length lens is the same as that of the longer, the screen brightness decreases. This observation is borne out by the last formula above, which shows that the f/number on the image side increases, and therefore the lens speed decreases, with increased magnification. Thus, we have the rule that for a given speed on the object side the speed on the image side decreases with increased magnification and vice versa.

Returning now to Fig. 2B, we note that the presence of the positive cylindrical lens in the top view causes the fan of rays to converge very rapidly toward the negative lens, and that after

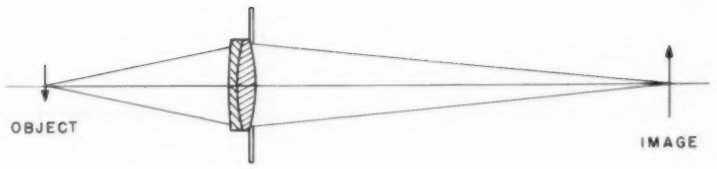

Fig. 1E. Corrected optical system.

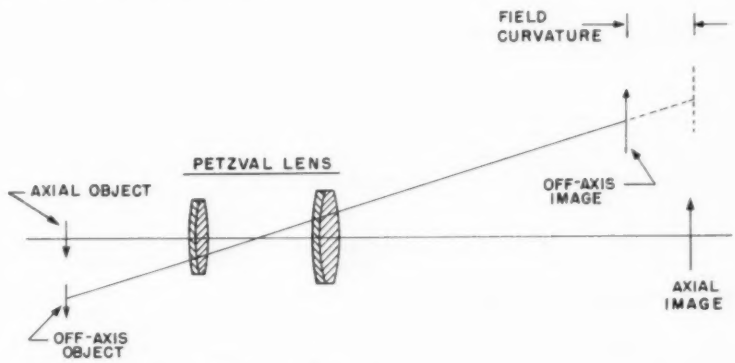

Fig. 1F. Off-axis aberration in an optical system.

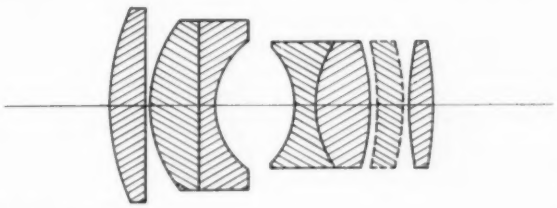

Fig. 1G. Double-Gauss projection lens.

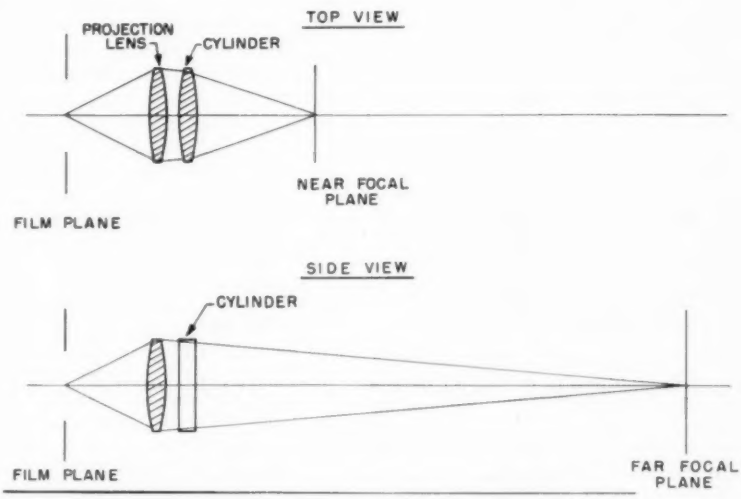

Fig. 2A. Projection lens with cylinder attachment.

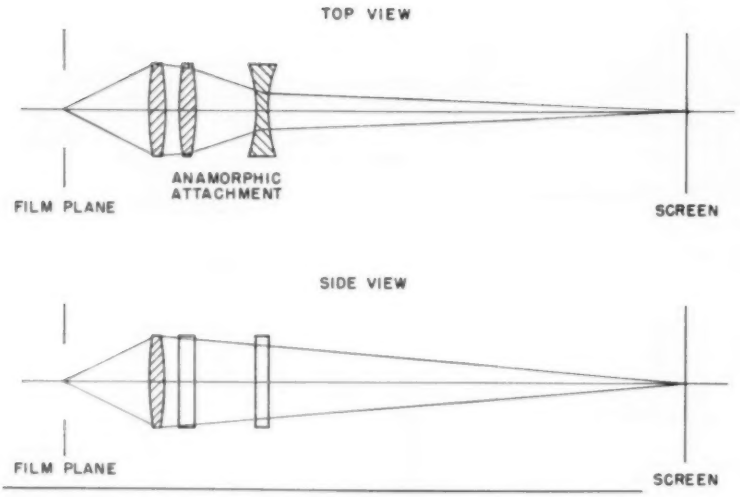

Fig. 2B. Projection lens with anamorphic attachment.

passing through the negative lens the fan is considerably reduced in speed compared to the fan in the side view. Since the speed of the combination of anamorphic plus spherical is precisely the same in the horizontal and vertical direction on the object side, we see that an increase in magnification has been attained in the top view or horizontal direction.

Thus far we have referred to the components of the anamorphic attachment simply as positive and negative cylindrical lens elements without regard to their focal lengths. As it turns out, fortunately from an economic point of view, the focal lengths of the cylindrical elements are not dependent upon the focal length of the projection lens. This means that a single anamorphic attachment can be used for a series of projection-lens focal lengths.

To obtain a given horizontal magnification from the anamorphic attachment requires only that the ratio of the negative focal length to the positive be equal to the desired horizontal magnification. Thus, in the actual case of CinemaScope projection where 2× horizontal magnification is required, the focal length of the positive cylindrical lens is twice that of the negative lens. The actual choice of focal length, e.g. whether the positive be +50 and the negative −25 mm, or whether the positive be +200 and the negative −100 mm has to be decided on the basis of a compromise between image quality, bulk and cost.

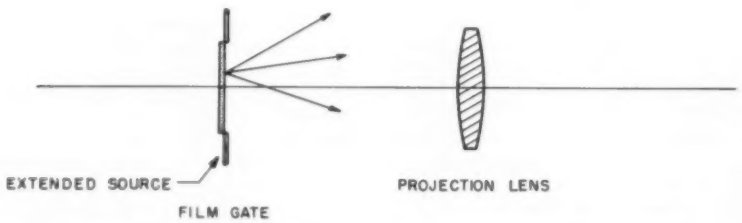

Fig. 3A. Extended-source illumination system.

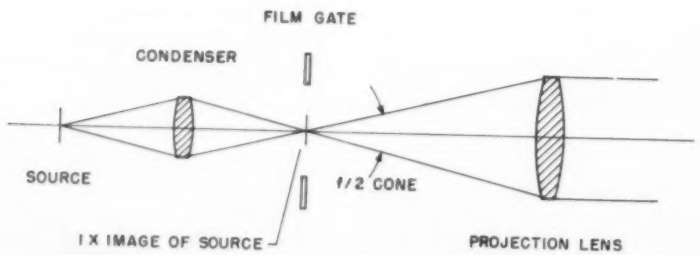

Fig. 3B. Illumination system: arc source imaged in the plane of the film gate at 1× magnification.

As was shown in Fig. 2B, to obtain an in-focus image on the screen requires that the negative lens push the near focal plane formed by the positive lens back to the far focal plane. Since the far focal plane will always be made to fall on the screen by adjusting the projection lens, and since this screen-to-lens distance will vary from one theater to the next, it becomes necessary that provision for focusing the anamorphic attachment be included in the mechanical design of the attachment.

If we turn the anamorphic attachment around so that the negative lens faces the projection lens, we find that where previously we had a 2× gain in horizontal magnification we now have a 2× reduction. If now we rotate the anamorphic attachment 90° about the axis of the projection lens so that the axes of the cylinders lie in a horizontal plane, we will again have the same width-to-height ratio that we had before reversing the attachment, but the picture dimension will be reduced to half the original dimensions.

When projection lenses of the required speed and focal length exist for normal anamorphic projection, there is no advantage in using the reversed anamorphic. For installations where the projection throw is abnormally long and where the projector head limits the speed of the long-focal-length lenses required, a definite gain in screen illumination can be had by using the reversed anamorphic. The focal length of the projection lens used with the reversed anamorphic will be exactly half the focal length which would have been required for normal anamorphic projection to produce a given picture size.

Screen Illumination Systems

The projection lens and anamorphic attachment, in order to perform their assigned task, must be backed up by an adequate illumination system. From the standpoint of getting the most light on the screen, the ideal illumination system is that shown in Fig. 3A, consisting simply of a surface which radiates uniformly in all directions, which is large enough to cover the entire film gate area, and which has a surface brightness adequate to provide whatever screen brightness is required.

It is to be noted that even this system falls short of being ideal from an overall consideration, since only a small fraction of the energy passing through and heating the film will serve as useful screen illumination; however, such a system would perform equally well without any kind of adjustment for projection lenses of all speeds and focal lengths and would improve the distribution of illumination on the screen to the point where only the vignetting within the projection lens and anamorphic

attachment would prevent perfect uniformity.

Since we are unable to make a source which simultaneously meets the requirements of size and brightness, we are forced to add optical components to our illumination system in order to overcome the shortcomings of the sources we have available. We shall confine this discussion to the carbon-arc source and shall use a lens-condenser system for the sake of clarity in the illustrations. In the carbon arc we have a source of sufficient brightness, but not of sufficient size, so the task of the condenser is to increase the size of the source optically without a reduction in brightness.

Referring to Fig. 3B, consisting of an $f/2$ projection lens, a film-gate area to be covered which is several times the area of the arc source, and a condenser lens, the condenser lens is adjusted to image the source in the plane of the film gate at $1\times$ magnification at a speed of $f/2$. No illumination is provided in the outer regions of the gate, but from the center of the gate the projection lens receives the same amount of light as it would receive if the source were physically located in the plane of the gate (minus the small transmission losses in the condenser).

Suppose, now, we double the size of the source image by increasing the condenser magnification to $2\times$. This requires that the condenser be moved backward away from the gate and, consequently, to maintain the $f/2$ speed on its image side requires that the condenser be made larger in diameter as shown in Fig. 3C. Now, as we have seen, the relationship between the f/numbers at which a lens works on its object and image sides is given by:

$$\text{/Number (Object Side)} = \frac{f/\text{Number (Image Side)}}{\text{Magnification}}$$

Since the condenser is working at $f/2$ on its image side at $2\times$ magnification, its f/number on its object side is $f/1$. This means it is now receiving four times the amount of light it had previously received, but since its magnification has been doubled, the source image is now just four times its previous area; consequently we have increased the size of the illuminated area without any change in illumination on the central portion of the gate. By a further increase in condenser magnification, accompanied by the required increase in condenser diameter, we can increase the size of the image of the source until it completely covers the film gate.

As we have seen, this illumination system will provide the same amount of light to the projection lens from the center of the gate as the projection lens would have received had we physically located the arc at the center of the gate. Although we have completely covered the gate with the arc image, this last statement will generally not be true for the outer regions of the gate even though each point in the gate receives the same amount of energy as the center. The reason for this is shown in Fig. 3D. If the projection lens is to receive the same amount of light from a point at the edge of the gate as it receives from a point at the center, the $f/2$ cone shown in the figure will have to be filled with light. But it will be noted that only the hatched portion of this cone can receive light from the condenser.

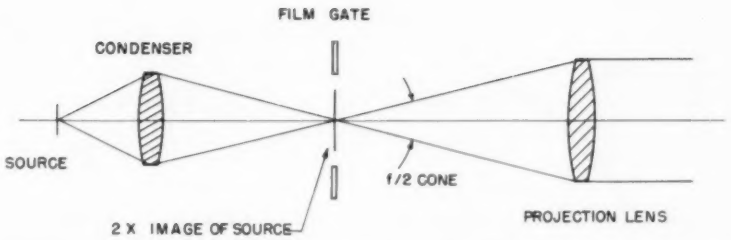

Fig. 3C. Illumination system: condenser magnification increased to $2\times$, doubles the size of the source image.

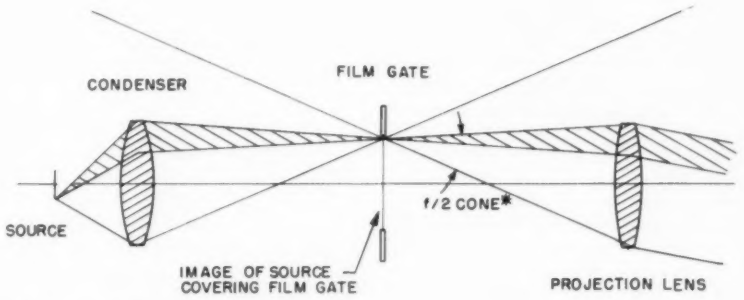

Fig. 3D. Optical illumination system.

It will also be noted that the bottom portion of the cone leaving the condenser misses the projection lens, so that while the film gate may be illuminated uniformly (within the limits of arc uniformity and the cosine effect) the image of the film gate formed on the screen by the projection lens will not be uniformly bright from point to point. Figure 3D shows the paradoxical situation, with which we must contend, of the condenser being simultaneously both too fast and too slow for the projection lens. The condenser is too fast because the energy contained in the bottom of the cone leaving the condenser reaches the film with a consequent heating of the film, but serves no useful purpose since the light in this portion of the cone never reaches the screen. The condenser is too slow because it does not fill with light the bottom portion of the cone in front of the projection lens.

We can increase the condenser speed beyond what we need to fill the projection lens on axis and thereby increase the amount of useful light the projection lens receives from the edge of the gate, but this gain in screen illumination will be accompanied by a much greater gain in the total amount of radiant energy incident on the film. Two further complicating factors in this problem of choosing the best condenser speed for a given speed projection lens are, first, the vignetting which occurs within the projection lens; and second, the effects of increased aberrations in the condenser as its speed is increased. Furthermore, there is the added problem of increased bulk in the lamphouse.

The foregoing discussion applies equally well to both refracting (lens) and reflecting condenser systems and we have used the lens system for ease of illustration. Since the reflecting system is in predominant use in 35mm projection, we shall close our discussion with two remarks concerning these reflecting systems. The first concerns the method of computing the f/number of the reflector. Figure 4 is a sketch of a reflector which is in actual use today. The true speed of this reflector is obtained by dividing the hypotenuse of the triangle by the free aperture of the reflector, which turns out to be $f/1.8$.

From time to time published articles appear which indicate that the f/number is obtained by dividing the axial distance between the face of the reflector and the film gate by the free aperture. By this latter method the reflector would appear to be $f/1.73$. This point is brought out for the benefit of those who might have occasion to construct a system in

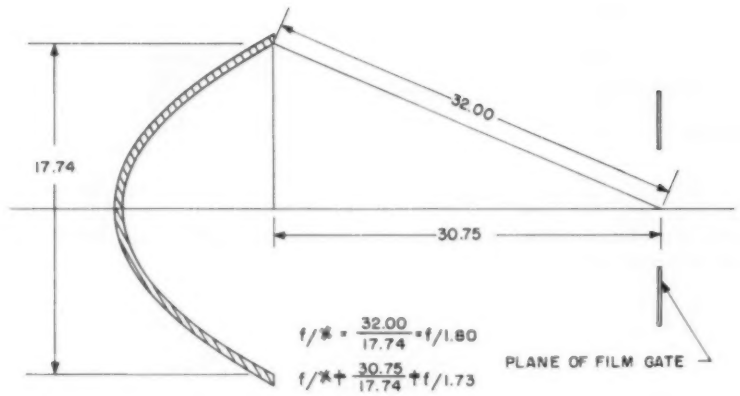

Fig. 4. Reflector f/number determination.

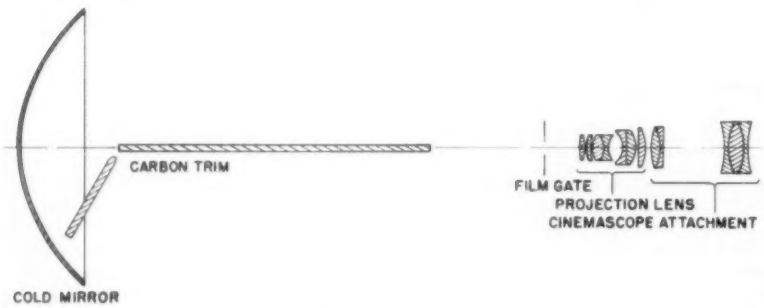

Fig. 5. Optical system for 35mm professional projection.

which the speed of the reflector is exactly equal to that of the projection lens. If the reflector speed is computed by the latter method, it will be too slow for the projection lens.

The final point of discussion concerns the recently introduced cold mirror. The cold mirror differs from the old-style silvered reflector only in the material used for its reflecting surface and the manner in which the material is applied. Instead of silvering, a series of thin nonmetallic films is evaporated onto the convex surface of the reflector blank. By carefully controlling the material, film thickness and sequence of these films, a highly selective reflecting surface is built up. The result is that in the visible region of the spectrum the reflectivity of this filmed surface is not less than 90% that of a silvered surface, while the total radiant energy incident on the film gate is reduced by not less than 35%. This means that for the same amount of screen illumination the film gate operates at a substantially lower temperature.

An alternative is to increase arc current to gain greater screen illumination without increasing film-gate temperature. This latter choice requires some modification in the lamphouse. The cold mirror currently on the market was designed to operate in conjunction with an arc drawing 90 to 120 amp. When the cold mirror is used with arcs drawing greater than 120 amp, reflector cooling must be provided. Without additional cooling, the reflector life is severely reduced.

Having considered each of the individual components of the projection optical system in some detail, it will be of interest to have a look at all of these components in combination. Figure 5 is a true scale drawing of a complete present-day projection optical system.

Film Pulldown Mechanism Based on a Design by Samuel B. Grimson

By FREDERICK T. O'GRADY

Before his death in 1955, Samuel B. Grimson* developed an ingenious film pulldown and film registration mechanism that formed a part of a special contact printer, designed specifically to achieve a "dot by dot" order of registration between the negative and positive films at the printer aperture, as is required for rendition by line-screen and reseau processes. Registration is derived from a claw and pilot-pin method that assures perfect registration between the films without any punching or bruising action by the claws or by the pilot pins. Grimson's mechanism is described by a man who for many years was associated with him and who designed and constructed most of his laboratory equipment.

COMMERCIAL contact printers, although capable of yielding prints which are quite satisfactory for most purposes, do produce minor variations in contact and registration which are detrimental in those applications where these factors are of utmost importance. Typical examples include those color processes which are dependent on using adjacent areas of the film to record the color information, such as the line-screen† method and the various reseau processes, such as Dufay color. In these cases a master copy, prepared by contact printing, takes the place of the original negative. Any lack of sharpness or registration in the internegative is ultimately reflected in color degradation and dilution as well as color variation.

The film pulldown mechanism described below offers a solution to the problem of producing high-quality contact prints for special purposes. The design incorporates several new principles, the soundness of which has been proven by actual performance.

Mechanism

As inferred above, it is always desirable and in many cases vital that (a) perfect contact be assured between the negative and positive films at the printer aperture and (b) the film frames be held in perfect registration at the printer aperture.

The first requirement can readily be met by taking advantage of the fact that the most intimate contact between two films occurs when the films are wrapped over a drum of fairly large diameter or over a curved surface.

In order to meet the second requirement, investigations were first made of conventional types of camera and printer film-claw and pilot-pin mechanisms. In such mechanisms, the claw pins are arranged to engage those perforations located adjacent to the pilot pins and, upon completion of the film-advancing stroke, are withdrawn from the film a distance of five perforations from the position of the pilot pins. Although these mechanisms have long been proven to be more than satisfactory for ordinary film production purposes — particularly when only one strip of film is involved, as in a camera — they did not meet the rigid requirements of those color processes where the printing demanded perfect registration of fine line-screen or reseau elements. Their failure to deliver the results demanded was traced to the fact that, in advancing two films that differ in perforation pitch through the printer, the perforations engaged by the claws were brought into registration upon completion of the film-advancing stroke, placing these in-register perforations a distance of five perforations away from the position of the pilot pins, and thus placing out-of-register perforations in the position where entry of the pilot pins would be made.

An exaggerated illustration of this condition is shown in A of Fig. 1, in which it will be seen that within the distance of six perforations — the distance between the pilot pins to the position of the claw pins — there appears a gradual increase in the amount of discrepancy in registration, which reaches its maximum in those perforations into which the pilot pins enter to register the frames of the two films. Since these perforations are out of register, they would necessarily be damaged to some extent when the pilot pins are thrust into them. No matter how slight this damage may be, the usefulness of the films to serve as a master negative is impaired.

As noted above, when using the conventional mechanism described, the maximum discrepancy in registration within the distance of six perforations lies within those perforations to be engaged by the pilot pins. However, the minimum discrepancy lies within those perforations which are engaged by the claw pins upon completion of the film-advancing stroke. It was this observation that led to the ultimate solution of the registration problem, for, if the completion of the film-advancing stroke could be arranged to occur immediately adjacent to the position of the pilot pins, instead of five perforations away from them, then the magnitude of differential between the perforations into which the pilot pins must enter would be reduced

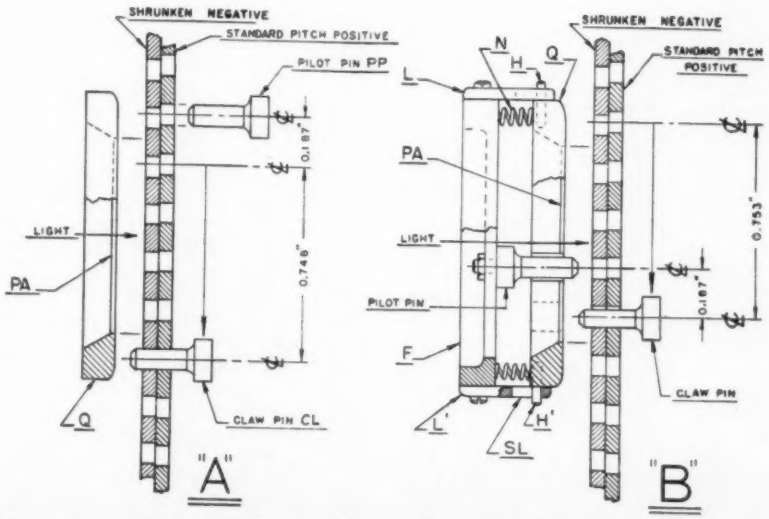

Fig. 1. Comparative conventional and improved claw and pilot-pin systems.

A contribution submitted on October 30, 1957, by Frederick T. O'Grady, 33–64 164th St., Flushing 58, N.Y.
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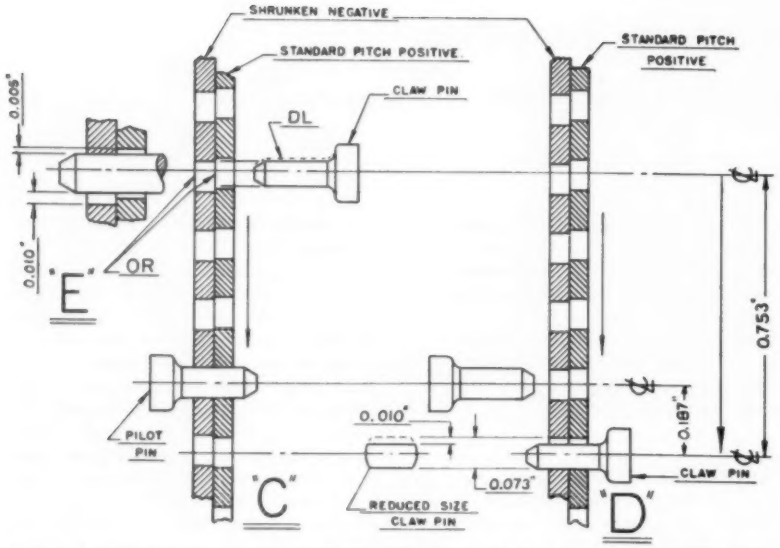

Fig. 2. Schematic representation of film-advancing stroke by claws and pilot pins of the mechanism.

to a negligible degree. The manner in which this result was accomplished is described below and illustrated in Fig. 3.

Referring to Fig. 3, the action of the film claws CL is governed by two cams C^1 and C^2. Both cams are fastened to and rotated by a driveshaft T. Cam C^2 rotates within the frame of the shuttle S and imparts a reciprocal motion to the shuttle by bearing upon the inner surfaces U and U^1 of the shuttle frame. Secured to the lower portion of the shuttle frame is a stud pin X, upon which a roller rotates as it rides within the grooved path Y forming cam C^1. A stem member V that forms part of the shuttle frame, slides within a sleeve member W. Sleeve W is rotatably supported upon a stem Z extending from a supporting plate M which is secured to the wall of the printer. Stem Z serves as the pivotal point upon which the shuttle swings in making its forward and backward strokes.

The stem member V attached to the shuttle frame slides up and down within sleeve W, as the shuttle is moved up and down to effect the entry and withdrawal of the claw pins CL that are attached to the lower end of the shuttle. With the stud and roller X connecting the shuttle to cam C^1, rotation of this cam provides the up-and-down motion (entry and withdrawal) of the claw pins, while rotation of cam C^2 provides the forward and backward motion (film advance) of the claws. In order to adjust the distance of travel of the claw pins, the pivot pin Z, by means of its supporting plate M, can be adjusted closer to, or further away, from the driveshaft T.

Located in the rear of the shuttle and also rotated by the shaft T, is a third cam C^3. This cam controls the action of the pilot pins PP and the action of the film pressure pad Q. Riding within the grooved path A forming cam C^3, is a roller rotating upon a stud pin X^1 secured to a bar B. Bar B is fastened to, and forms a bridge, connecting two vertical shafts D and D^1. When cam C^3 is rotated, the shafts ride up and down within their supporting bearings E and E^1. Carried upon the lower end of the shafts and extending outward to a position beneath the printer aperture PA, is a bracket F, upon which are supported the pilot pins and the film pressure pad.

In operation, the three cams C^1, C^2 and C^3 are relatively timed in the usual manner to govern the film-advancing action of the claws, the action of the pilot pins and the pressing action of the pressure pad. It will be noted that the pilot pins PP are secured directly to the bracket F, and that the pressure pad Q rests upon four coil springs N, suitably placed near each corner of the pad. These springs are arranged to constantly bear upon the upper surface of the bracket F, thereby resiliently holding the pad in a position that separates it from the bracket. Centered and extending outward from the sides of the pressure pad are two guide pins H and H^1 that engage with elongated slots SL that are milled into two guide plates L and L^1 attached to the ends of the bracket F. The slots of the guide plates serve to restrict the upthrust of the pressure pad while, at the same time, they permit the pad to be compressed. (This arrangement is illustrated more clearly in B of Fig. 1.)

Since the pressure pad and the pilot pins are both supported by the bracket F, their up-and-down motion will be synchronous with the up-and-down motion of the shafts D and D^1. When the shafts are in their lowered position, the pressure pad is separated from all contact with the negative film, and the pilot pins are completely withdrawn from the film perforations. While the pad and the pilot pins are in the lowered position, the films, both negative and positive, are entirely free to be advanced frame by frame by the claw pins CL, to bring the successive frames in position at the printer aperture PA. During the periods of film advance, a rotating disk-shutter (not shown) attached to the driveshaft T, prevents the printer light from reaching the film. The printer light source (not shown) is located in the rear of the printing machine, and rays from this source are directed to the printer aperture PA by a prism K.

Upon completion of the film-advancing stroke by the claws CL, the pilot pins PP are then raised by the bracket F to engage and register the negative and positive film perforations. Before the pilot pins have reached their maximum raised position within the perforations, the pressure pad Q contacts with the base of the negative film. Upon making contact, the guide pins H and H^1 extending from the pressure pad begin to slide downward within the slots of the guide plates L and L^1 to permit a continuing upward motion of the bracket F, while at the same time exerting a resilient pressure upon the pressure pad. By this continuing action of the bracket F, the springs N are further tensed and the pressure pad levels with the films, whereupon the springs then urge the pressure pad into close contact with the films, thus forcing the films together in close and even contact with the curved plate G of the housing R.

In Fig. 3, the claw pins CL are shown engaged within the film perforations after having advanced the negative and positive films a distance of one frame. The pilot pins PP are shown in position just prior to their being raised to engage and register the film perforations. With the pilot pins thus engaged, the claw pins are simultaneously returned to their starting position as indicated by the dotted lines J. It will be noted that in making the forward and backward strokes, the claw pins pass over and clear the tips of the pilot pins. As a result of this arrangement, it is possible for the registering action of the claws and the pilot pins to take place within the group of perforations that border the picture frame at the printer aperture.

This particular arrangement is an important contribution to the successful performance of the film-pulldown system, for it is by this arrangement that (a) the registering action takes place squarely within the confines of the picture frames that must be registered in order to produce perfect color reproduction; and (b) it is possible to position those perforations that have been registered by the claw pins immediately adjacent to the position of the pilot

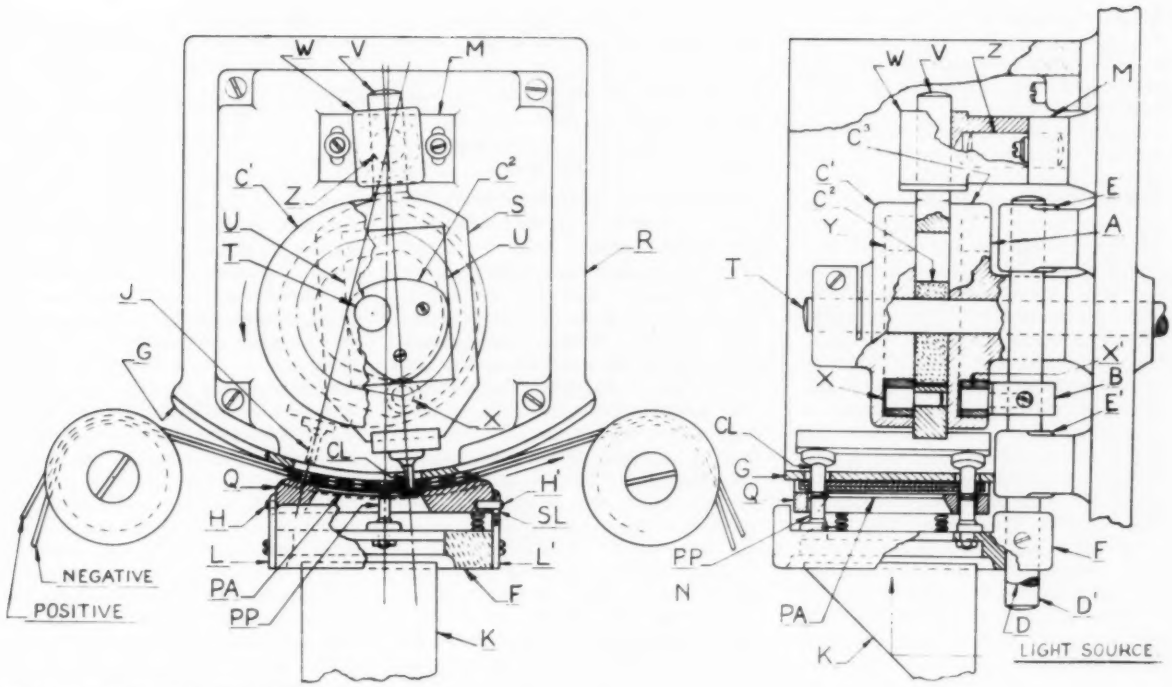

Fig. 3. The film pulldown mechanism.

pins, so that the final registering action of the pilot pins may be accomplished with a minimum of effort. It also makes it possible to end the return stroke of the claw pins a distance of only three perforations ahead of the pilot pins instead of the customary five perforations.

Two important advantages are gained by the arrangement just described. These advantages will become apparent when it is remembered that the extent of differential in perforation pitch that may exist between the negative and positive films increases from one perforation to the next, the further the perforations are from those held in register by the pilot pins, as clearly illustrated in Fig. 1. Therefore, since by the arrangement described, it is possible for the claw pins to engage the film perforations a distance of only three perforations from the position of the pilot pins, and to end the forward stroke immediately adjacent to the position of the pilot pins, the differential between the perforations at these two most important positions will be reduced to a minimum.

In order to emphasize the advantage gained over conventional systems by the special claw and pilot-pin arrangement just described, two important stages of the two systems are illustrated in A and B of Fig. 1. The arrangement shown in part A approximates the claw and pilot-pin system used in the Bell & Howell Unit I shuttle mechanism, which among the conventional systems is recognized as producing accurate registration results. It is for this reason that this arrangement is chosen for comparative purposes. The A and B systems are illustrated side by side and of the same exaggerated dimensions, so that the most important difference between the two may be more clearly shown and understood. Special attention is drawn to the fact that, contrary to conventional systems as shown in A, the special system B can operate only with the claw and pilot pins arranged on opposing sides of the films.

In practice, the conventional systems may vary in respect to the positioning of the picture aperture PA relative to the position of the claw and pilot pins. However, the functioning of the claw and pilot pins remains basically as shown in the illustration. In order that the two systems may be presented in the same manner for comparison, both are shown as operating in a straight, vertical line. However, it will be apparent that, although the special system is designed primarily to be used with the claw pins CL traveling through an arc, with the films and the aperture plate Q curved as shown in Fig. 3, it is obvious that the system can also be operated to equal advantage if it is arranged to operate in a straight line with the films held flat by a flat aperture plate, as illustrated in B of Fig. 1 and in C and D of Fig. 2.

Referring to Fig. 1, the badly shrunken negative films shown in A and B are represented as having the same degree of shrinkage, and the positive films are represented as being of normal, undeveloped, raw-stock proportions. The negative and positive films are also represented as having been advanced a distance of one picture frame, with the claw pins CL still engaged within the film perforations. The pilot pins PP and the film pressure pad Q are shown completely withdrawn from the films. It will be noted that those perforations of the negative and positive films that are engaged by the claw pins are in register. It will also be noted that, starting from these in-register perforations, the perforations begin to go out of register, and that the magnitude of their discrepancy increases from one perforation to the next, the further the perforations are spaced away from the in-register perforations. However, insofar as their usefulness for frame-by-frame advancement and registration of each frame is concerned, the perforations need only be considered as being made up of separate groups. When considering conventional claw and pilot-pin systems, each group will consist of six perforations.

One such group is illustrated in A of Fig. 1, in which the group of six perforations is shown as being situated from the centerline of the pilot pins to the centerline of the claw pins. The claw pins are shown as having completed a film-advancing stroke. With the claw pins engaging the film perforations as shown, the maximum discrepancy in registration within the group of six perforations will lie within those perforations into which the pilot pins must enter to register the picture image. The purpose of the pilot pins, however, will be thwarted, for when the pilot pins are thrust into

the perforations of the shrunken negative film, the edges of these perforations will be impaired, and thus render the film useless for the special purposes heretofore described.

Such damage to the negative film perforations is averted by the special claw and pilot-pin arrangement, illustrated by B in Fig. 1, in which the claw pins are shown in position as having come to rest within the negative and positive film perforations after having completed a film-advancing stroke. It is important to note that in this instance the end of the film-advancing stroke now places those perforations engaged by the claw pins immediately adjacent to the pilot pins, instead of a distance of six perforations from the pilot pins. Therefore it is now possible for the pilot pins to engage and register perforations that have a minimum amount of discrepancy in registration — within the effective group — instead of having to engage and register perforations that have a maximum amount of discrepancy. The differential will be so slight that entry of the pilot pins can be made without any damaging effect. Particular attention is drawn to the fact that, by reason of the special arrangement of the claw and pilot pins shown in B, it has been possible to reduce the effective number of perforations within each group, from six to four, when measured in the same manner as for the conventional systems, from center to center of the claw and pilot pins.

The claw and pilot-pin arrangement of the conventional system, as described above and illustrated in A of Fig. 1, has dealt solely with the damage that the perforations might incur when the pilot pins are thrust into them. It naturally follows that, since the perforations held by the pilot pins are in register, the perforations that are spaced six perforations away, and into which the claw pins will be thrust at the start of their film-advancing stroke, will be out of register. Therefore, the entry thrust of the claw pins will also cause damage to the perforations.

The manner in which the special system performs to prevent damage to the perforations of badly shrunken negative films is shown in C, D and E of Fig. 2. Illustration C shows the pilot pins engaged with the perforations, and the claw pins are shown as they are about to be thrust forward into the film perforations to start a film-advancing stroke. It will be seen that the claw pins in this instance are located above, instead of below, the pilot pins, and that their centerline is spaced a distance of only "four" perforations from the centerline of the pilot pins. It will also be seen that the thickness of the claw pins has been reduced by 0.010 in. by removing this amount from one side only of the centerline of a normal, full-size claw pin. In operation, the full side of the pins is arranged to face in the direction of the film travel, so that full and positive contact with the base of the perforations will be maintained.

In conventional types of film-advancing mechanisms such as illustrated in Fig. 1, the size of the claw pins, particularly in thickness, is approximately equal to the size of the perforations. The distance of their travel is precisely equal to the distance between corresponding points on the adjacent picture frames of a normal, unshrunk film. In the case of standard 35mm motion-picture films, the distance of travel of the claw pins is 0.748 in. In the present instance, however, the stroke of the claws is increased to 0.753 in. and, in adjusting the stroke, the forward action is arranged to end with the normal centerline of the claws the normal distance of 0.187 in. from the centerline of the pilot pins. So adjusted, the return stroke will then travel the distance of 0.753 in. thus carrying the claws a distance of 0.005 in. beyond the normal distance of 0.748 in.

Assuming that the negative and positive films are both of standard perforation pitch, it will readily be seen that, by thus increasing the distance of the backward stroke of the claws which are 0.010 in. undersize, entry of these claws into the film perforations will be made without their contacting either the fore or aft edges of the perforations, the clearance from both edges being 0.005 in. The clearance of 0.005 in. thus provided is calculated to be more than sufficient to prevent damage to film perforations when the negative and positive films are used which vary in perforation pitch; for, even under extremely abnormal conditions, the negative and positive films rarely differ in perforation pitch to the extent of 0.005 in. within the distance of four perforations.

Assuming that there is such a differential in perforation pitch between the negative and positive films, the reduced-size claw pins will then perform in the manner shown in C, D and E of Fig. 2. In C, the claw pins are shown as they are about to be thrust forward into the out-of-register perforations or to start their film-advancing stroke. The 0.010-in. reduction in the thickness of the claw pins is indicated by the dotted lines DL. The straight reference lines directed from the upper and lower sides of the claw pins to the positive film perforation, show the 0.005-in. clearance from the top and bottom edges of these perforations.

It will be noted that the upper reference line is in line with the upper edge of the negative film perforation. Therefore, when the claws continue their forward thrust and enter the shrunken negative film perforations (as illustrated in E), the top side of the claws will be substantially in contact with the upper edge of the perforation, and the lower side of the claw pins will clear the base edge of the perforation by approximately 0.010 in.

Simultaneously with the entry of the claw pins, the pilot pins are withdrawn, and the pressure pad (not shown) is released, thereby allowing the films to pass freely through the printer. Having freed the films from contact with the pilot pins and the pressure pad, the claw pins then start their film-advancing stroke. In so doing, the claws first close the 0.005-in. gap between the lower side of the claws and the base of the positive film perforation. When contact has been made, the claws and the positive film move ahead together another 0.005 in., whereupon contact is made with the base edge of the shrunken negative film perforation. With both gaps closed, the negative and positive films move together and, as the stroke of the claw pins continues, the claws bear upon the base of the perforations to hold them in register and to place them below and immediately adjacent to the perforations to be occupied by the pilot pins.

Illustration D of Fig. 2 shows the claw pins resting within the film perforations after having completed the film-advancing stroke, and the pilot pins are shown as they are about to enter and register the perforations that lie immediately above those that are engaged by the claw pins. Attention is drawn to the fact that, within the perforations to be engaged by the pilot pins, there is a minimum amount of discrepancy in registration. Therefore, when the pilot pins make their entering thrust into these perforations, the perforations can be accurately registered with each other with a minimum amount of effort and without any damaging results.

Results

Performance of this mechanism produced extremely accurate registration and perfect contact between the negative and positive film. The resultant copies had excellent definition and sharpness of the line-screen and the reseau elements as determined by microscopic examination.

Xenon High-Pressure Lamps in Motion-Picture Theaters

ABSTRACT

By HEINZ ULFFERS
Abstracted by Y. G. Hurd

XENON high-pressure lamps rated at 1000 and 2000 w have been used with success in over a hundred 35mm theater installations in West Germany and in other European countries. These installations are in theaters with less than 500 seats and with screen widths of about 30 ft for standard projection and 40 ft for CinemaScope projection. Although the lamps do not have sufficient output for larger screens, they do provide these advantages:

(1) Spectral energy distribution similar to daylight (Fig. 1);

(2) Light output of 25–35 lm/w compared to 15–27 lm/w for tungsten lamps;

(3) Constant spectral distribution with lamps of different wattage rating and with any particular lamp operated at various amperages;

(4) No service or maintenance requirement during use, because there are no combustion by-products, such as ashes, gases or copper particles which may damage the interior of the lamphouse and its optical elements;

(5) Fixed position of light source with respect to optical elements of illumination system giving constant light distribution over the screen; and

(6) Simple starting with no warm-up necessary.

Xenon Zeiss-Ikon Lamphouse

The first commercial lamphouses were provided with an Osram 1000-w xenon lamp Type XB01001 and were sold by Zeiss-Ikon to theaters under the trade name Ikosol II X. This lamphouse is shown in Figs. 2 and 3. Recently, lamphouses have been made available with a 2000-w xenon lamp Type XBO2001.

At the present time, three types of xenon lamps are available (Figs. 4 and 5). Some data on these are given in Table I of the paper by Reese in this issue of the *Journal*. Because the bright luminous area in the xenon arc is small (see Fig. 6 in the paper by Reese, p. 395), the Zeiss-Ikon lamphouse employs a honeycomb condenser (Fig. 3) to provide uniform illumination at the aperture.

In addition to the main projection mirror which throws the light and image of the xenon lamp onto the honeycomb condenser, there is a spherical mirror directly in front of the xenon lamp which reflects an inverted real image of the arc back onto the arc itself. Depending upon the optical arrangement, the illumination is increased by 30 to 45%. A crater reflector working along the optical axis is used to aid this adjustment. The arc with its superimposed mirror image can be seen on the ground glass of this reflector, mounted in the wall of the lamphouse (see Fig. 7 in the paper by Reese, p. 395).

Xenon-Lamp Power Supply

About 65-v d-c is required to operate the xenon arc, but 76-v is generally used to avoid the drop in line voltage. Excessive voltage ripple is harmful to xenon lamps and may cause the tip of the cathode to break out or to produce cauliflower patterns (see Fig. 8 of the paper by Reese, p. 396), which cause increased tungsten evaporation and blackening of the envelope. Further, the striking and hence the steadiness of the arc are affected. All these factors reduce lamp life.

Because the d-c voltage in itself is not sufficient to penetrate the gas under high pressure inside the envelope, a high-frequency discharge voltage of about 20,000 to 40,000 v is necessary for striking the arc. This high voltage is supplied by a special ignition unit which is in the negative wiring of the lamp.

Unfortunately, the heavy spark discharge of the ignition unit may be heard over the loudspeaker and, to avoid this, the lamps in both projectors are usually struck before the beginning of the show. During the show, only the lamp in the projector being used is kept at full capacity and amperage, while the xenon lamp in the other projector is maintained at about 12 amp. However, with this so-called stand-by service, lamp life is naturally reduced.

To remedy this, a special ignition relay was developed which short-circuits the amplifier input during ignition and therefore prevents any noise from reaching the audience. The principle of this

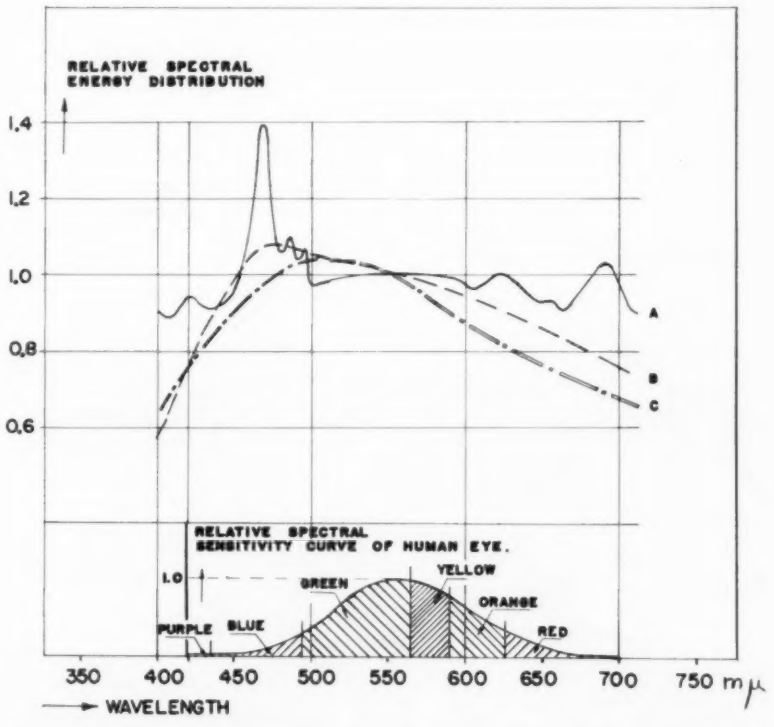

Fig. 1. Relative spectral distribution of various light sources. A, xenon arc (Osram); B, average daylight; C, 50-amp, high-intensity arc.

Presented on October 10, 1956, at the Society's Convention at Los Angeles by Walter Beyer, Motion Picture Research Council, 6660 Santa Monica Blvd., Los Angeles 38, for the author, Heinz Ulffers, Zeiss Ikon AG., Werk Kiel, Kiel-Wik, Mecklenburger Strasse 32–36, Germany. *Abstract* contributed by Y. G. Hurd, with special assistance of Otto Wantuch, Twentieth Century-Fox Film Corp., 444 West 56 St., New York 19.

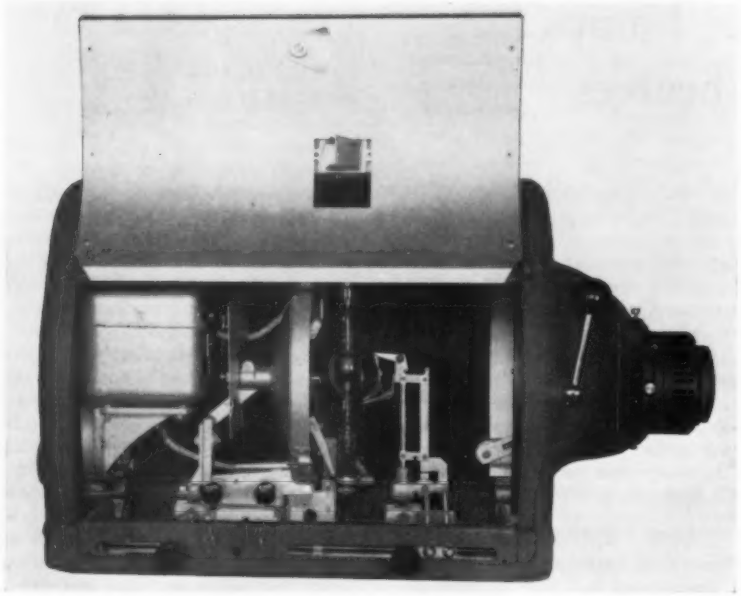

Fig. 2. Zeiss-Ikon lamphouse.

Table I. Power Consumption, Light Output and Image Size for Three Lamp Models.

	XBO 501		XBO 1001		XBO 2001	
Power Consumption						
New Lamps	15–23 amp		25–38 amp		40–60 amp	
Old Lamps	18–25 amp		30–45 amp		45–70 amp	
Light Output						
Full load	1200 lm		3000 lm		5000 lm	
Normal use	500–1000 lm		1000–2400 lm		2000–4000 lm	
	Standard	Cinema-Scope	Standard	Cinema-Scope	Standard	Cinema-Scope
Diffuse white screen, width	6–8 ft	8–11 ft	6–14 ft	9–19 ft	13–19 ft	18–26 ft
Screens with gain of about 2 times white from the audience viewing area, width	9–13 ft	13–18 ft	11–21 ft	16–29 ft	19–27 ft	26–39 ft

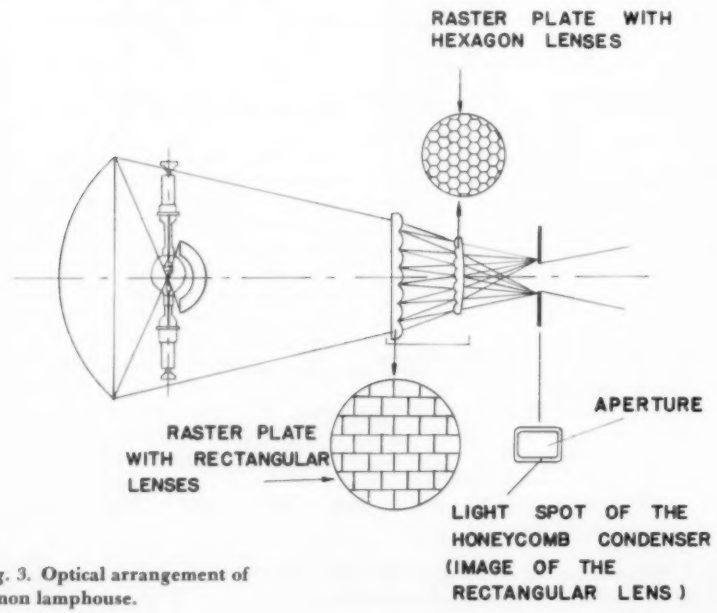
RASTER PLATE WITH HEXAGON LENSES
APERTURE
RASTER PLATE WITH RECTANGULAR LENSES
LIGHT SPOT OF THE HONEYCOMB CONDENSER (IMAGE OF THE RECTANGULAR LENS)

Fig. 3. Optical arrangement of xenon lamphouse.

arrangement is shown in Fig. 6. For four-channel magnetic sound reproduction, it is necessary to short-cut the inputs of all four channels. The ignition relay functions as an automatic switch which operates over a 0.1-sec period and is unaffected by the length of time the projectionist may keep the button down.

Xenon-Lamp Operating Data

In Fig. 5, luminous flux has been plotted as a function of amperage for Ikosol II Xenon Lamps. The data were compiled under full operating conditions, with the projector running and no film in the gate. Accuracy of the data is approximately ±10%, due to variations in the characteristics of the lamps. Because the envelope blackens during the lifetime of the lamp, the light output is decreased by approximately 20 to 25%.

To maintain constant light output for the entire life of the lamp, new lamps are operated at 15 to 20% below maximum light output current, and the amperage is increased to compensate for light loss due to blackening as the lamp ages. There is a minimum amperage, however, below which older lamps will not burn steadily.

Table I indicates screen brightnesses and screen widths possible at various amperages for Ikosol xenon lamps. The screen width is given for a brightness of 10 ft-L in the center of the screen. It is evident that the three types of xenon lamps are adequate to illuminate small-size screens commonly used in review rooms of laboratories and film exchanges (frequently only 7 ft in width), as well as those used in medium-size theaters, and in those cases providing a single type of light source from the color balancing operation in laboratories to the screen in the theater. Since the xenon light has a spectral distribution similar to the high-intensity carbon-arc light, prints balanced with xenon light are equally correct in color balance for projection with high-intensity carbon arcs.

The mean lifetime of the xenon high-pressure lamp has been considerably increased during the last few years. The first lamps lasted about 800 hr. However, they suffered severe blackening of the envelope with reduction of light output up to 40%. Improvements in the selection of materials for the electrodes have prolonged the life of the lamp and reduced light output losses, as specified in Table I of the paper by Reese, p. 393.

The figures given for maximum lifetime include certain operating tolerances. In some cases, the crystal structure of the quartz envelope undergoes gradual change under the influence of the high operating temperature and the active radiation of the xenon arc. This reduces the strength of the envelope. At the same time, there is a tendency for the electrodes to oxidize from the outside into

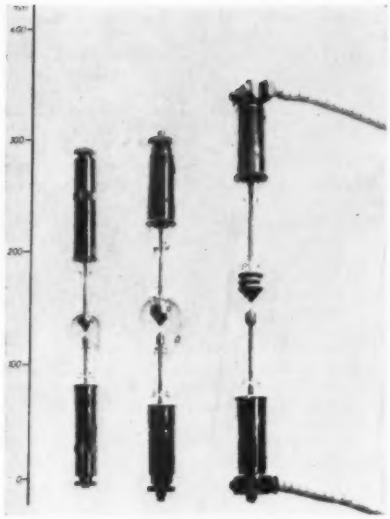

Fig. 4. Xenon short-arc lamps XBO 501, 1001 and 2001.

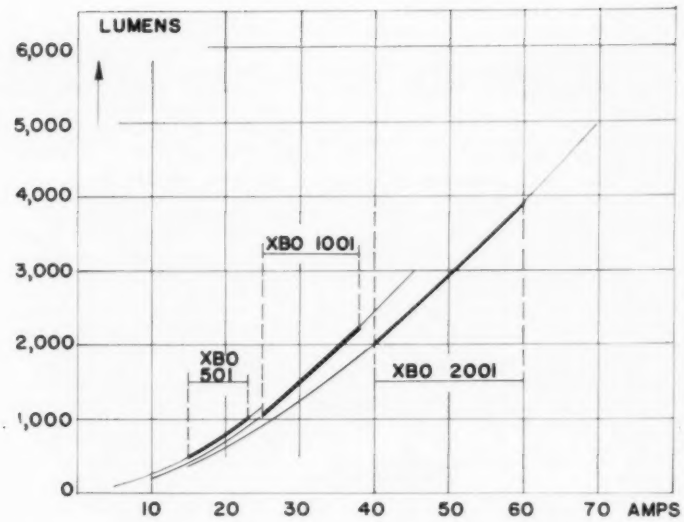

Fig. 5. Output and amperage range of Ikosol II Xenon Lamps.

the envelope, which has a negative effect on the melting points, and eventually causes a slight leakage. Both these factors tend to destroy the lamp in time. Therefore, as a good maintenance practice, it is recommended that the lamps be replaced when maximum lifetime, as given in Table I of the paper by Reese, has been reached, whether or not the lamp still operates.

Safety of Xenon Lamp

Because of the tremendous pressure inside the lamp, a few safety rules are necessary. The lamps are delivered in a protective envelope of a thermoplastic material. This protective cover should not be removed until the lamp has been inserted in the holders within the lamphouse. Figure 7 shows such a lamp in its thermoplastic cover. It is essential that the xenon lamp should be enclosed in this protective cover whenever it is outside the lamphouse. While working on an open lamphouse, the operator must always wear protective glasses, supplied with the lamps. Fortunately, in the last 3½ years, there have been no accidents with the xenon lamp.

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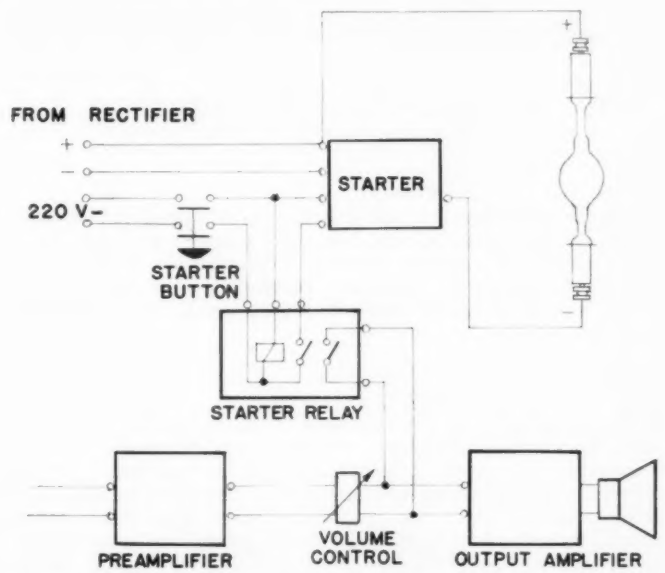

Fig. 6. Ignition system of the Ikosol II Xenon Lamps.

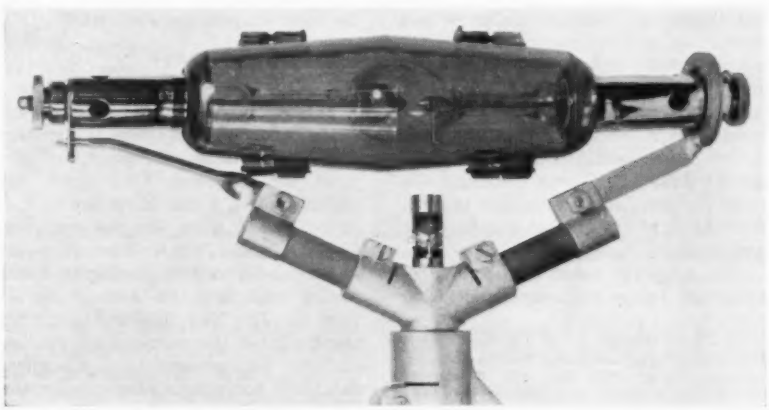

Fig. 7. Xenon lamp with thermoplastic cover.

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The Xenon-Arc Projection Lamp

By WARREN B. REESE

Xenon-arc lamps have inherent properties as to spectral energy, luminous efficiency, electrical operation, and geometrical characteristics which make them attractive from both a technical and an operational point of view as a new light source for motion-picture projection. Practical experience with European installations is reported, supplementing the report immediately preceding in this issue of the Journal.

DURING the past twenty years gaseous-discharge-type lamps have been utilized in many illumination applications which formerly employed tungsten filament lamps or carbon-arc lamps. However, none of the gaseous discharge lamps was suitable for motion-picture film projectors, for set lighting, for film printers, or for graphic arts three-color photographic separations, because of poor color rendition. Gaseous-discharge-type lamps have inherent spectral deficiencies, especially with respect to the red end of the spectrum. In addition, spectrum lines, such as found in fluorescent and mercury-type lamps, are usually deleterious to the rendition of color. Xenon gas-filled discharge lamps overcome this color problem, thereby making possible their use in place of carbon arcs for color applications.

The apparent color temperature of xenon-arc lamps is approximately 6200 K. In addition to good color composition or spectral characteristics, the xenon-arc lamp provides a constant color temperature and spectral radiation over a wide range of lamp operating current values. This means that the light output of the lamp can be varied, independent of color temperature, over a wide range (brightness ratio of 10 : 1). In all other light sources when intensity is varied, the color temperature also varies.

Types of Xenon Lamps and Their Application

There are two types of xenon-arc lamps, generally described as short-arc and long-arc lamps. For projection purposes the short-arc XBO series are recommended. These lamps are for d-c operation and three sizes are available, 500-, 1000- and 2000-w. These lamps do not require forced-air cooling or water cooling and have an average life of 1000 hr. The XBF long-arc lamps are also available, but require water cooling and will be discussed later. Complete data and operating conditions for the long- and short-arc xenon lamps are shown in Table I. These lamps are in production and have been used in the field for about four years. The lamps are all instant-starting.

The use of xenon-arc lamps in motion-picture projectors has proven successful in Germany and other European countries in theaters of less than 500 seats and with screen widths of 30 ft for standard 35mm projection, and 40 ft for CinemaScope projection.

Practical results of projection equipment using xenon-arc lamps indicate certain advantages. In operating a carbon-arc projector, it is necessary for the operator to change carbons from time to time, trim, adjust arc reflectors, focus, remove combustion by-products from the lamphouse and clean optical elements. Today the projectionist also monitors equipment for four-channel magnetic sound, and present objective lenses require more critical focusing with respect to film and arc position. Projectors using xenon-arc lamps provide comparatively simpler handling, less maintenance, cleaner operation for any length of film, and the projector is always ready for use. Also, the optical adjustment, with respect to the projector lens, when once established remains constant, assuring uniform quality of the projection light.

In addition to projection applications, xenon short-arc lamps, because of their small arc area and high brightness, are an ideal source for spotlighting stage and sets. Such spotlights require a concentrated light beam with a long range

Presented on October 5, 1957, at the Society's Convention at Philadelphia by Warren B. Reese, Macbeth Corp., P.O. Box 950, Newburgh, N.Y. This paper was prepared jointly by Macbeth Corp. and Osram, Munich, Germany.

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Fig. 1. Spotlight for 1000-w XBO-1001 or 2000-w XBO-2001 Xenon Lamp.

heretofore obtainable only with a carbon arc. Figure 1 shows a spotlight, manufactured by Reich and Vogel in Berlin, which can be equipped with either the 1000- or 2000-w xenon short-arc lamp. Note the ignition equipment mounted on the vertical stand below the spotlight.

The xenon long-arc lamps shown in Fig. 2 are presently available in two sizes, 6000- and 1000-w. In the long-arc lamps, the arc is encased in a quartz capillary, otherwise referred to as the arc burner. Because the heat load of the capillary walls is high, water-cooling is necessary. Xenon long-arc lamps of intermediate wattages are presently in the stage of development.

The 1000-w long-arc lamps have a

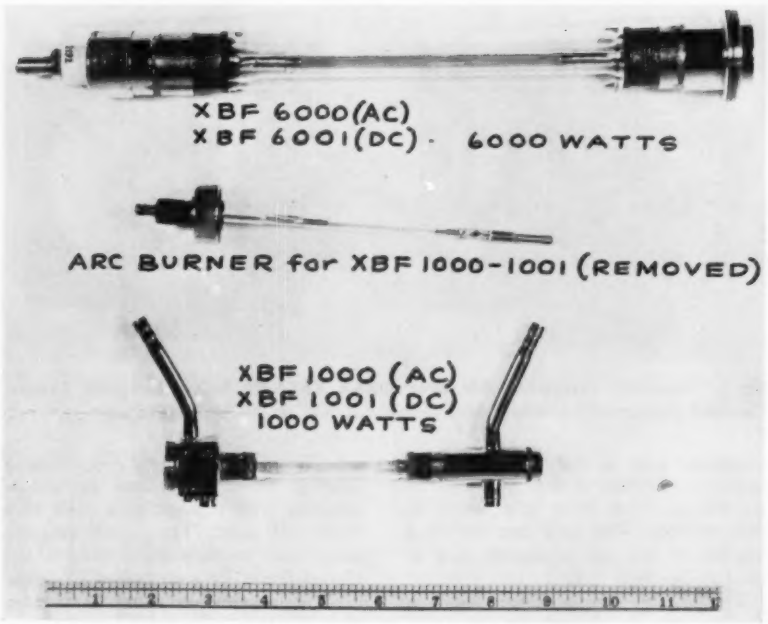


Fig. 2. Xenon long-arc lamps.

Table I. Operating Conditions for Osram Xenon Short-Arc and Long-Arc Lamps.

Lamp Designation	XBO-501	XBO-1001	XBO-2001	XBF-6000	XBF-6001
Type of current	d-c	d-c	d-c	a-c	d-c
Supply voltage, v	≧65 d-c	≧65 d-c	≧65 d-c	220 a-c	200 d-c
Operating voltage,[1] v	20	22	26	135	165
Max. operating current, amp	25	45	70	45	36.5
Power consumption,[1] w	500	1000	2000	6000	6000
Luminous flux,[1] 1m	13,500	32,000	70,000	215,000	205,000
Candlepower,[1] cd	1500	3500	7500	18,500 (30,000)[3]	17,300 (28,000)[3]
Size of arc (width × height), mm	1.2 × 2.4	1.7 × 3.4	2 × 4	Length of Arc 110 mm ($4\frac{5}{16}$ in.)	
in.	0.047 × 0.094	0.067 ± 0.134	0.079 × 0.158		
Brightness,[1,2] cd/cm²	30,000	40,000	65,000	3000 (4500)[3]	3000 (4500)[3]
Ignition voltage (peak value), kv	30	33	40	15	15
Average life, hr	800	1200 (1000)[4]	1000 (800)[4]	600	1000
Permissible capacity of igniter cable, pF	25	35	45	50	50
Distance in air between igniter cable and metallic parts (rule for guidance), mm	40	50	60	>20	>20
in.	$1\frac{5}{8}$	2	$2\frac{3}{8}$	$\frac{13}{16}$	$\frac{13}{16}$

[1] Average values. [2] Referred to size of arc (line 8). [3] With lamp silvered on one side. [4] With stand-by operation.

removable arc burner and the replacement cost is lower than the short-arc of the same wattage size. At this time, the 6000-w long-arc lamp must be returned to the manufacturer for burner replacement but the cost of replacement remains low, nevertheless.* Because of the arc-burner replacement feature, the re-

* 6000-w lamps will soon be manufactured with the removable-arc-burner feature, no longer requiring the lamps to be returned to the manufacturer.

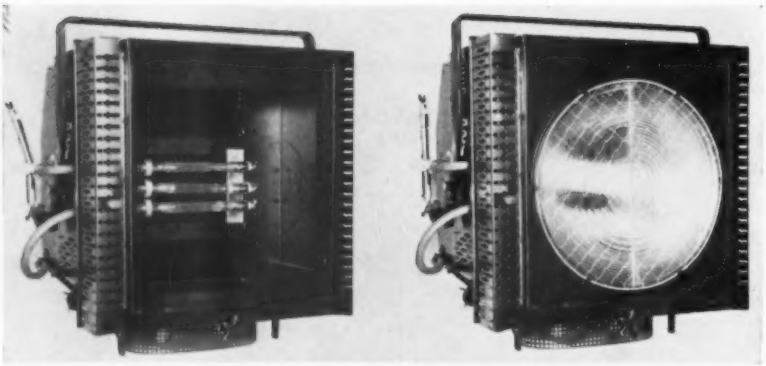


Fig. 3. Luminaire equipped with three 6000-w XBF-6000 Xenon Long-Arc Lamps. This unit produces 600,000 lm.

placement cost of the xenon long-arc lamps is a fraction of that of the short-arc lamps, which must be replaced in their entirety. Also they operate for a fraction of the cost of carbon arcs of comparable light output.

The long-arc type of xenon lamps is suitable for flood-type set or stage illumination. Figure 3 shows a Luminaire, also made by Reich and Vogel, with three 6000-w long-arc lamps, three-phase, connected to an a-c power supply. Due to the three-phase wiring, flickering of the illumination is practically non-existent. The total luminous flux for this floodlight is 600,000 lm.

The xenon long-arc lamps have not made much progress in film and television studio sets or stage illumination because the water-cooling encumbers the lighting equipment and therefore limits the flexibility of the Luminaire. Flexibility, however, may be increased with the development of intermediate wattage long-arc lamps, as each Luminaire can be constructed with its own integral water-cooling system.

Xenon long-arc lamps are suitable for use in film printing, repeater-type printers, fadeometers and in photographing with daylight-type color film where still used. The xenon long-arc lamps have recently been tested in the United States for copy board illumination in graphic arts for three-color photographic separation, with excellent results.

Comparison of Xenon- and Carbon-Arc Optics

Because the operating characteristics of the xenon lamps differ considerably from those of the conventional carbon-arc lamps, a different projection optical system is required. Comparison of the two sets of operating characteristics will provide a better insight for discussing the optical systems for xenon lamps.

The brightness distribution of the positive crater for both high- and low-intensity carbon arcs is shown in Fig. 4. The shape of the brightness distribution indicates that the carbon arc is uniform from the center outward until it falls off rapidly at the edges. This symmetrical brightness distribution lends itself to relatively simple optical treatment in a motion-picture projector.

As a result, two basic types of optical systems are used with carbon-arc lamps and are illustrated by the schematic diagram in Fig. 5. In the reflector optical system, the image of the positive carbon crater is reflected by a mirror onto the film aperture. In the condenser optical system, the light from the positive carbon crater is collected by the condenser lenses and imaged on the film aperture. Since, as depicted in Fig. 4, brightness distribution of the carbon crater is symmetrical and reasonably uniform, these optical systems produce an evenly illuminated film aperture which is necessary to obtain even screen brightness.

As indicated earlier, the xenon short-arc lamps cannot be used in the same optical system as carbon arcs because of the unevenness of the arc brightness distribution, which is shown by the curve to the left of Fig. 6. The photograph at the lower right shows that a bright gas or plasma ball is formed adjacent to the cathode. This area of the arc is about ten times the average brightness of the entire arc and is indicated by the peak on the left portion of the brightness distribution curve. From this it may be seen that the xenon discharge is not even or round, but bell-shaped.

If the bell-shaped brightness distribution pattern were imaged in the film aperture, using the optical system employed with carbon arcs, the light distribution on the screen would be uneven. Although the bell-shaped brightness pattern could be diffused by a light-scattering material inserted between the condenser lens or mirror and the film aperture, resulting in a more even brightness distribution, this method would cause serious loss of light and prove unsatisfactory.

In order to obtain even illumination, hence even screen brightness with high luminous efficiency, an optical system such as that shown schematically in Fig. 7, has been developed and put into operation by Zeiss-Ikon. This projection optical system features a honeycomb condenser consisting of two lens scanning plates which jointly form a multiple intermediate imaging system. An auxiliary mirror is used in front of the xenon lamp which collects and reflects to the main mirror the forward-emitted light from the xenon lamp. Use of the auxiliary mirror not only increases the light efficiency of the system but also improves the evenness of the arc image brightness distribution on the film aperture. This is accomplished by a second image of the ball-shaped arc which is inverted and superimposed on the image produced by the main mirror directly. A photograph of the double image is shown at the right of Fig. 7.

Projectors made by Bauer of Stuttgart

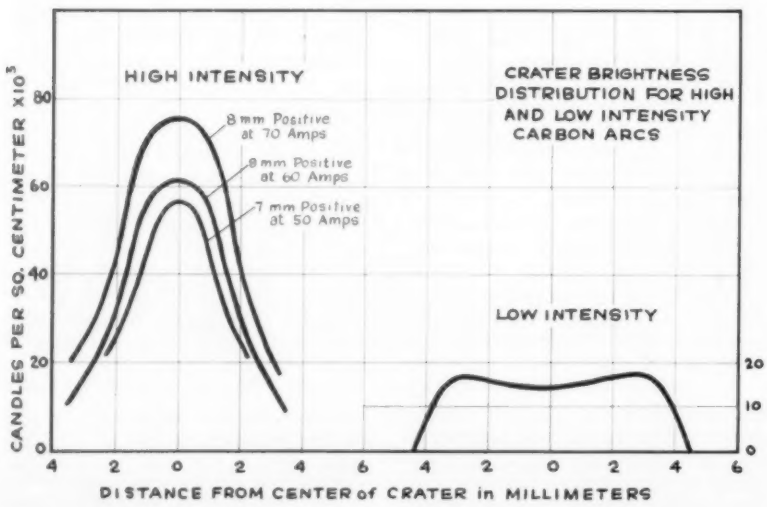


Fig. 4. Crater brightness distribution for high- and low-intensity carbon arcs.

also use an auxiliary mirror. In projectors made by Frieseke and Hopfner, the light from the xenon-arc lamp is reflected downward by a concave mirror onto a plane mirror. The plane mirror reflects the visible light onto the plane of the film aperture while the infrared energy is transmitted through the mirror, thereby reducing the heat in the light beam markedly. When various wattages of xenon-arc lamps are used in projectors, the amount of useful light flux available with the projector running without film is shown in Table I of the paper by Ulffers in this issue of the *Journal*.

Inasmuch as useful light flux is the amount of light available for projection after all losses from optical elements, reflecting surfaces and projector shutter action, the total lumen output of a light source is basically independent of the light source itself. The 500-w lamp produces between 500 and 1000 useful lumens, depending upon operating current from 15 to 23 amp. The 1000-w lamp produces 1000 to 2400 useful lumens with operating current from 25 to 38 amp, while the 2000-w lamp produces from 2000 to 4000 useful lumens with operating current from 40 to 60 amp.

Operation of Xenon Short-Arc

The light output from a xenon short-arc lamp decreases during the rated life of the lamp by 20 to 25% due to the blackening of the arc envelope. Since it is desired to maintain constant screen brightness during lamp rated life, a new lamp should be operated at 80 to 85% of its maximum operating current. This leaves adequate operating current reserve to compensate for the drop in light output by gradually increasing the operating current as the lamp ages. The useful luminous flux values set forth in Table I of the paper by Ulffers are maintained values, having been evaluated to include light depreciation due to aging.

The xenon short-arc lamps require a 65-v d-c minimum supply voltage, while the operating voltage will vary from 20- to 26-v d-c, depending upon the wattage size. The d-c supply voltage

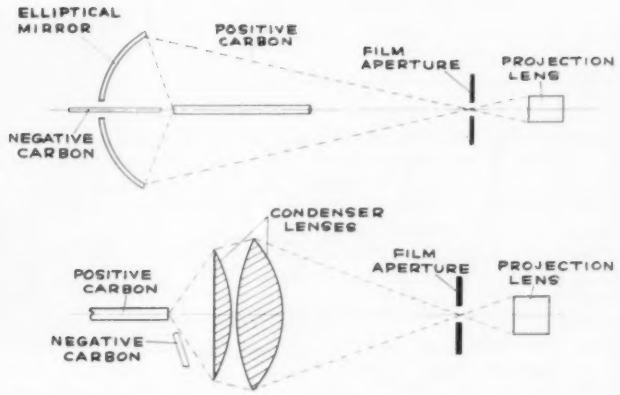


Fig. 5. Reflector and condenser optical systems for carbon arcs in motion-picture projectors.

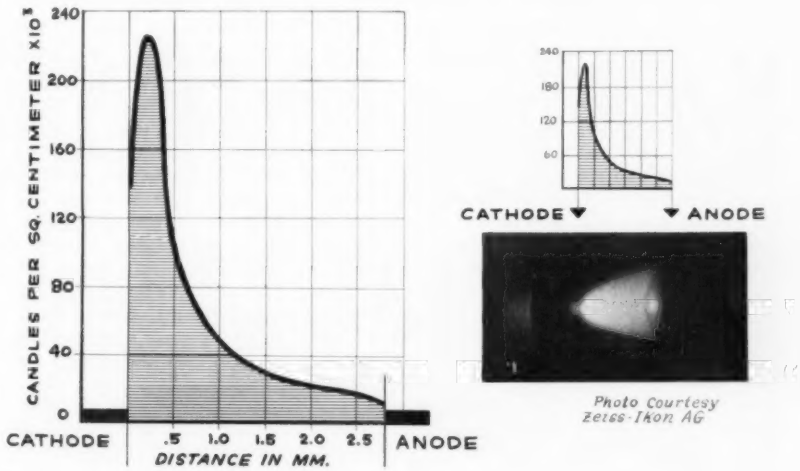


Fig. 6. Xenon short-arc brightness distribution.

is not enough to ignite the xenon-arc lamps; consequently, an igniter is required to provide a high-frequency discharge voltage of 20,000 to 40,000 v. The ignition voltage is sufficient to penetrate the high-pressure gas inside the envelope and ignite the lamp. Excessive voltage or current ripple will cause the tip of the cathode to deteriorate, as indicated at the right of Fig. 8. This deterioration accelerates the tungsten evaporation of the cathode and blackening of the envelope, resulting in a reduction of lamp life.

The deformation of the cathode may be avoided by making certain that the operating current pulsation does not exceed 17%, i.e., the minimum rectified a-c current should be at least 83% of the maximum current. A graph showing the pulsation of current with ripple in excess of 17% by the curve labeled "without smoothing" and lower than 17%

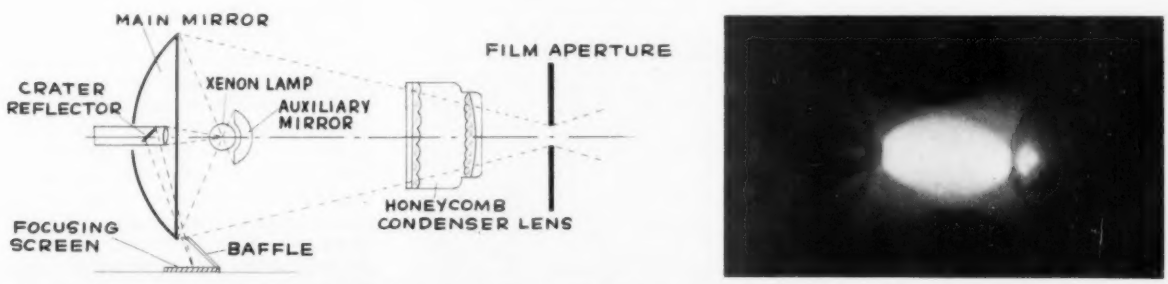
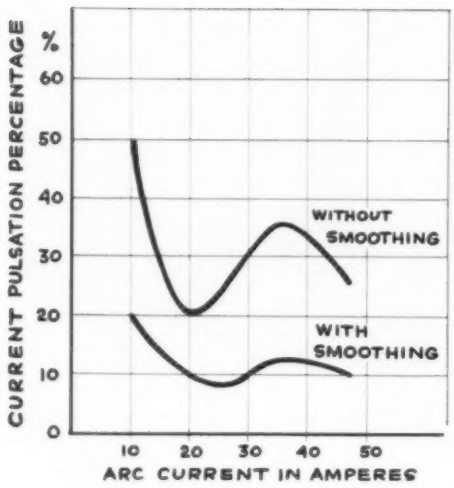


Fig. 7. Schematic of optical system used with xenon short-arc lamps in motion-picture projectors. Right: Double image of xenon arc reflected first from the main mirror and second from the auxiliary mirror. (Photo, courtesy Zeiss Ikon AG.)



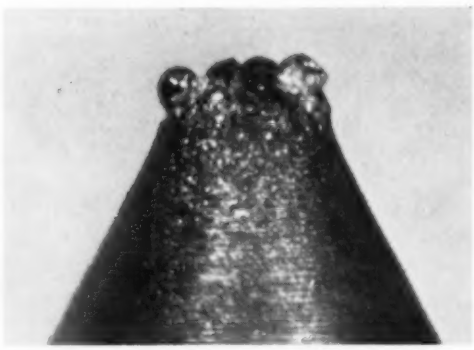


Fig. 8. Left: Pulsation of current $\frac{(I\ max\ -\ I\ min)}{I\ max}$ with 50-amp rectifier and 1000-w XBO-1001 xenon lamp. Above: Deformed cathode of 2000-w XBO-2001 Xenon Lamp resulting from exceeding permissible (17%) current pulsation. (Photo, courtesy Zeiss Ikon AG.)

by the curve labeled "with smoothing" is shown at the left of Fig. 8.

Table I of the paper by Ulffers shows the wattage of xenon short-arc lamps which will produce a center screen brightness of approximately 10 ft-L when viewed from the center of a theater for several types and sizes of screens. The largest width screen which can be covered by a 2000-w lamp is about 50 ft, as applied to CinemaScope projection in a long narrow theater on a smooth, silver screen. This makes it possible to examine and balance color film in the film laboratory with the same-type xenon-light source used for projection in small and medium-size theaters, all other factors such as screens, etc., being equal.

A number of film laboratories in Europe are using xenon-arc lamps for projection purposes. It is not possible to complete the standardization for larger indoor theaters and outdoor drive-in-theaters because the higher wattage xenon short-arc lamps which would be required are not yet available. However, higher wattage lamps are now being developed which it is hoped will fill this need and cover the complete projection applications.

The most frequently used xenon lamps for projection purposes are the XBO-1001 (1000-w) and the XBO-2001 (2000-w) lamps. These two lamps can replace the carbon pairs shown in Table II. Again it is important to note that the useful luminous flux includes losses from projector optical design and are not indicative of the total lumen output available from either a carbon-arc or a xenon-arc lamp.

The present delivered-in-U.S.A. replacement cost of the Osram/xenon short-arc lamps is approximately 17.5¢ per hour for the 500-w lamp, 19.8¢ per hour for the 1000-w lamp and 30¢ per hour for the 2000-w lamp. As these lamps are used in greater volume, it is expected that the replacement cost will be lower.

Safety of Xenon Lamps

There is some danger in handling xenon lamps because of the high internal gas pressure; however, the xenon lamp will cause no difficulty if a few simple safety rules are followed. The lamps are delivered in a protective envelope as shown in Fig. 7 in the paper by Ulffers. This envelope should be kept on the lamp any time it is outside the lamphouse or Luminaire. If it is necessary to work on an open lamphouse or Luminaire, then the operator should wear protective glasses. Xenon lamps do not blow up unless they are electrically misused or are mishandled or dropped. There have been no accidents in the last three and a half years with Osram xenon lamps used in motion-picture film projectors; furthermore, no accidents for any application of Osram xenon lamps are known where they have been properly handled and operated.

Table II. Carbon Pairs Which Can Be Replaced by Xenon Short-Arc Lamps.

Diameter of carbon pairs, mm		Useful luminous flux of carbon pairs, lm*	Carbon-arc wattage	Replacement xenon short-arc lamp
Positive	Negative			
6	5	2600–3600	900–1400	XBO-1001 (1000-w)
6.5	5	2800–4400	1050–1660	XBO-2001 (2000-w)
7	6	3300–5000	1440–2090	XBO-2001 (2000-w)
7.5	6	3700–5600	1700–2340	XBO-2001 (2000-w)

* Values of luminous flux for carbon pairs according to manufacturer, Conradty, Nurnberg.

Conclusion

The advantages of the xenon lamps, which have become apparent as the result of practical experiences, are enumerated in the Abstract of the paper by Ulffers earlier in this issue of the *Journal*.

The economic and technical advantages of xenon-arc lamps are such that their use has begun in some applications and is a possibility in others where carbon-arc lamps might be specified.

The prospects for increasing the light output of xenon lamps may be considered. The performance of the short-arc lamp seems to be limited to approximately 3000 to 4000 w. Any increase in this direction can be obtained only with a concommitant increase in amperage, since the operating voltages for such lamps are relatively low. Amperages in theaters are unlikely to exceed the limits for high-intensity carbon arcs of approximately 135 amp. Some slight increase in the efficiency of existing lamps might be achieved by development of better optical systems. There seems to be a good possibility of an appreciable increase in light output by changing over to intermittent or pulse operation. The xenon lamp is especially suited for this type of operation, since it responds instantaneously, and the maximum output can be synchronized with the shutter. This type of operation has thus far been unsuccessful, because lamp life is dependent upon the purity of the d-c current supply.

Automatic Television Film Editing

By ROBERT GRUNWALD
and RICHARD WALLACE

Requirements for film editing in a television operation differ from those in any other branch of the motion-picture industry. Inspection must be accurate. A complete equipment, known as the Inspect-O-Film Editor, has now been designed to perform all the steps of inspection simultaneously. Operating details of the machine are discussed with emphasis on how it functions in actual operation.

THROUGHOUT THE television industry film plays a vital part in programming. Types of film range from news film, photographed and oftentimes processed by a station itself, to feature films which may be in questionable physical condition. A great number of stations rely almost entirely on film for their programming.

The problems which face a film director in a TV station have no equivalent in any other operation. The film handling techniques which are used for production, varied though they are, find only limited application in a television station operation. Also, the techniques used in a film library are of restricted value.

Excellent equipment has been developed for handling various types of film operations in the motion-picture industry. Until the development of the Inspect-O-Film Editor, no film handling equipment had been designed primarily for TV stations.

Consider the problems facing the film director of a typical station, for example.

There is a mechanical inspection which should be of equal or greater accuracy than that obtained in a film library operation.

Another particularly crucial problem in television film is the inspection for content. This is due to the great variety in film sources and in particular to the process of bicycling film from station to station which makes the contents of film even more questionable.

The problem of inspecting for scratches is of comparable significance to 35mm theatrical film distribution.

Due to the extremely competitive nature of the TV film business, oftentimes film will be released with any number of soundtrack defects. A film can be out of sync, it can "motor boat," contain excessive ground noise, improperly blooped splices and inadequate high- or low-frequency response. A station film director will have to determine policy, and remedy or reject defective film.

He must also time each film to determine whether it will fit into its alloted period. The usual method is by a sprocket-driven counter. It is important to have a highly efficient system for this, since this operation may be repeated several times for a given film.

For some portion of a station's film programming, it will be necessary for the director to insert commercials. He has two basic techniques: one is to drop a specified length of opaque leader, called a "stop-down," into the film at the point where the insert is to be made and then to project commercials on a separate film chain. The other technique is to insert the commercial itself into the main film.

One of his most involved duties and also one of the most highly skilled in TV film operation is that of cutting to time, as few feature films are of such a length as to permit broadcasting them in their entirety. Certain portions of the film must be cut without detriment to the overall entertainment value. Compared to a director of theatrical film production, the station film director has a great deal less time to devote to editing.

Finally, he must see that all film is cleaned either by dusting or liquid treatment before it is put on the air.

After the film has been televised, commercials or stop-downs must be removed and in many cases the removed sections of film returned to their proper position.

The Inspect-O-Film Editor, shown in Fig. 1, unites all these necessary steps into one efficient and largely automatic operation. Figure 1 shows the front of the machine. In normal use, the "heads up" film is placed on the lefthand spindle and

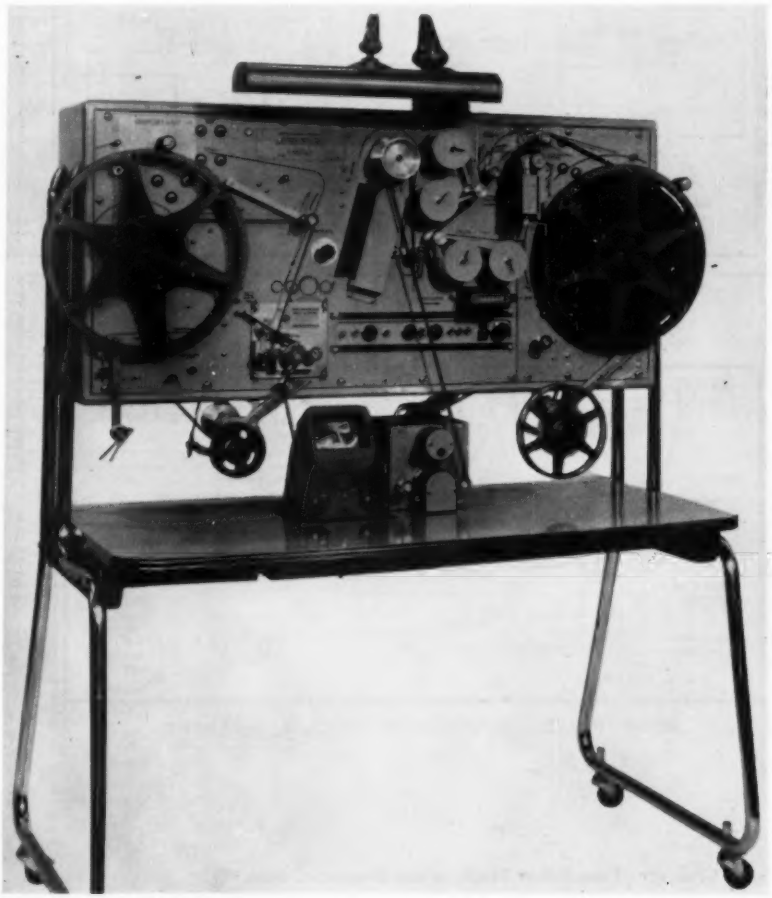


Fig. 1. The Inspect-O-Film Editor.

Presented on October 11, 1956, at the Society's Convention at Los Angeles by Robert Grunwald and Richard Wallace (who read the paper), The Harwald Co., 1245 Chicago Ave., Evanston, Ill.
(This paper was received on January 21, 1957.)

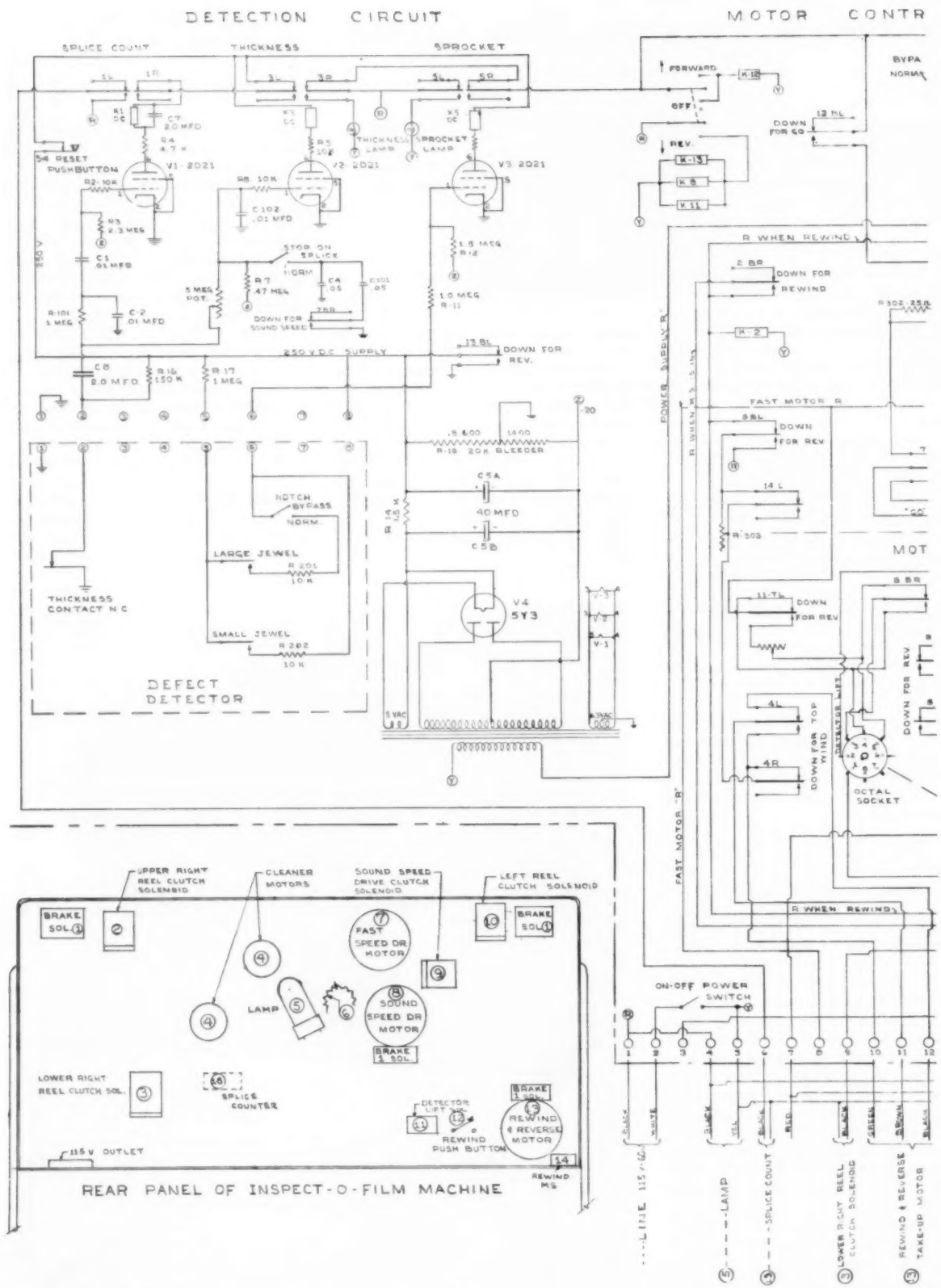
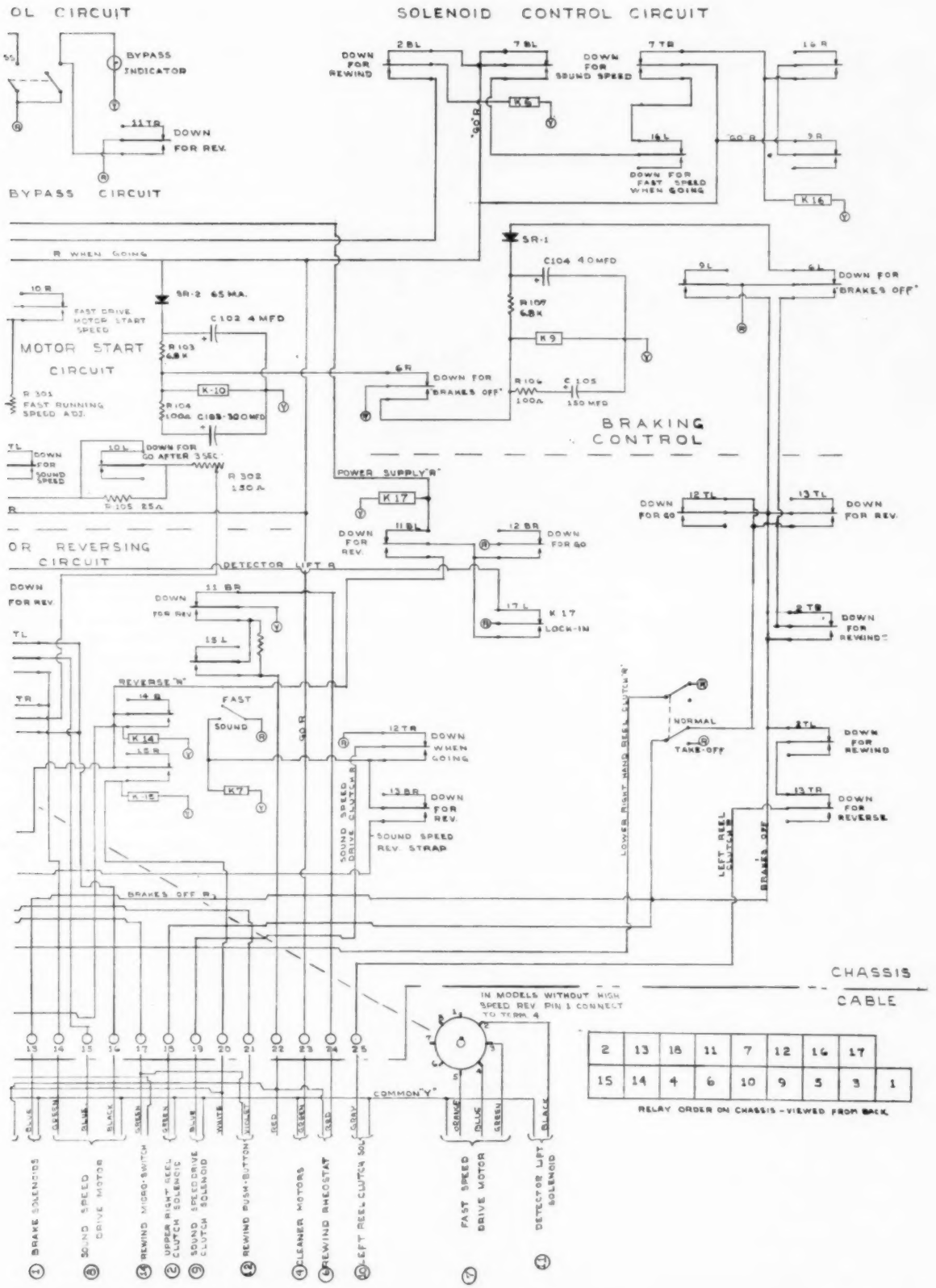


Fig. 2. Circuitry of the Editor Model of the Inspecto-O-Film "Q."


OL CIRCUIT
SOLENOID CONTROL CIRCUIT
BYPASS INDICATOR
11 TR DOWN FOR REV.
BYPASS CIRCUIT
DOWN FOR REWIND
2 BL
7 BL
DOWN FOR SOUND SPEED
7 TR
16 R
K 6
90 R
16 L
DOWN FOR FAST SPEED WHEN GOING
60 R
9 R
K 16
R WHEN GOING
SR-1
C104 4 MFD
9 L
6 L
DOWN FOR BRAKES OFF
10 R
SR-2 65 MA.
FAST DRIVE MOTOR START SPEED
C102 4 MFD
MOTOR START CIRCUIT
R 103 6.8 K
R 301 FAST RUNNING SPEED ADJ.
K-10
R 104 100Ω
C 103 320 MFD
K 9
6 R
DOWN FOR BRAKES OFF
R 106 100Ω
C 105 150 MFD
BRAKING CONTROL
T L
DOWN FOR SOUND SPEED
10 L
DOWN FOR GO AFTER 3 SEC.
R 302 150 A
R 105 25 A
R
POWER SUPPLY "R"
K 17
DOWN FOR REV.
11 BL
12 BR
DOWN FOR GO
12 TL
13 TL
DOWN FOR REV.
OR REVERSING CIRCUIT
DETECTOR LIFT R
DOWN FOR REV.
11 BR
DOWN FOR REV.
15 L
17 L
K 17 LOCK-IN
2 TR
DOWN FOR REWIND
T L
T R
REVERSE "R"
14 R
FAST
SOUND
K 14
15 R
K 15
K 7
90 R
12 TR
DOWN WHEN GOING
13 BR
DOWN FOR REV.
SOUND SPEED REV. STRAP
SOUND SPEED DRIVE CLUTCH R
NORMAL
TAKE-OFF
LOWER RIGHT HAND REEL CLUTCH "R"
2 TL
DOWN FOR REWIND
13 TR
DOWN FOR REVERSE
LEFT REEL CLUTCH
BRAKES OFF
BRAKES OFF R
CHASSIS
CABLE
IN MODELS WITHOUT HIGH SPEED REV. PIN 1 CONNECT TO TERM. 4
COMMON "Y"
13 14 15 16 17 18 19 20 21 22 23 24 25
Black Green Blue Black Green Green Black White Violet Red Green Red Gray
Orange Blue Green Black
2 13 18 11 7 12 16 17
15 14 4 6 10 9 5 3 1
RELAY ORDER ON CHASSIS - VIEWED FROM BACK
1 BRAKE SOLENOIDS
8 SOUND SPEED DRIVE MOTOR
14 REWIND MICRO-SWITCH
2 UPPER RIGHT REEL CLUTCH SOLENOID
9 SOUND SPEEDRIVE CLUTCH SOLENOID
12 REWIND PUSH-BUTTON
4 CLEANER MOTORS
6 REWIND RHEOSTAT
10 LEFT REEL CLUTCH SOL.
7 FAST SPEED DRIVE MOTOR
11 DETECTOR LIFT SOLENOID

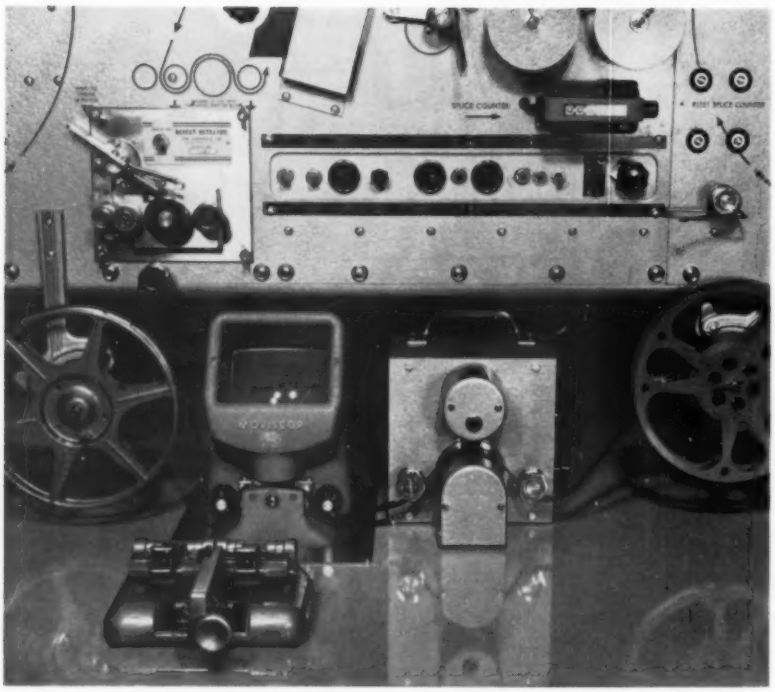


Fig. 3. Closeup of the Inspect-O-Film Editor: viewer and sound reader set.

then threaded over the snubber arm into the defect detector, through the viewer and sound reader, over the drive capstan, through the cleaner tapes and footage counter, and onto the take-up reel.

Figure 2 traces the circuitry of the Editor Model of the Inspecto-O-Film "Q."

The defect detector, shown in the upper left of Fig. 3, operates essentially the same as the unit on the Model H Inspect-O-Film discussed in a previous *Journal* paper.* It will detect any important mechanical defect in the film, such as an enlarged sprocket hole, sprocket punch, cut sprocket holes and defective splices. When such a defect is found, the machine will stop automatically, and an indicator lamp will show the nature of the defect on the control panel (see Defect Detector in Fig. 3). This electronic inspection permits heretofore unattainable dependability for film programming.

Accurate inspection for scratches is permitted by the Moviscop (Fig. 3) which is imported for use on the Editor. The Moviscop, which uses a 25-v lamp and an effective heat filter, allows single-frame as well as action viewing and keeps the film completely safe at the same time. Due to the relatively low mass and friction of the mechanism, it is possible to use the viewer at all speeds including the maximum normal running speed of the machine (450 ft/per min). The viewer includes attachable vignettes which mask the picture area so as to approximate the field of the home TV screen. Another feature is an edge marker which indicates the exact point where a cut should be made.

The sound reader and viewer are spaced to give 26 frames sync distance in order that lip sync may be easily and accurately checked. There is no possibility that the film can be threaded so as to give an inaccurate representation of the synchronization of the sound and picture.

The capstan is smooth and is the principal drive point of the system. The film may be propelled from speeds of 2 frames/sec to speeds in excess of 400 ft/min — both forward and reverse. Cleaner tapes are identical to those on the Model H Inspect-O-Film. They are of a special high-pile velvet, are chemically treated to remove film dirt and move automatically. An optional attachment will perform liquid cleaning. The footage counter illustrated here is driven by a low mass, 16-tooth sprocket wheel.

A large work surface is provided so that even a highly complex editing job may be carried out without cramping the operator. For inserting and removing commercials and stop-downs, two auxiliary spindles are provided. The feed reel spindle is in the lefthand corner next to the viewer and the take-off spindle is just to the right of the sound reader. Both spindles are power driven so that, if desired, a small film, such as a 100-ft reel of news, may be edited by working between these two spindles with a maximum of convenience and a minimum of threading. These spindles will hold a 400-ft reel, as shown in Fig. 3.

After the film has been televised, the commercials and stop-downs may be removed either by running the film from heads to tails or tails to heads. It is possible to run the film from tails to heads on the machine, thereby saving rewinding and at the same time making it possible to finish with the film heads up, both for the commercials and for the body of the film. Inasmuch as the film will be feeding off the top of the reel rather than the bottom, it is necessary to set the reverse and rewind on the machine to insure a correct wind. For this purpose the "top wind-bottom wind" switch is simply set in the top-wind position for tails-up films and in the bottom-wind position for heads-up films.

In using the machine for editing, the operator makes a preliminary check for length, then watches sections of the film before deleting any of it. As an example, some western films have an extended chase at the beginning which can be easily eliminated or at least shortened.

The operator can watch this section at a speed somewhat higher than sound speed, which will still permit him to pick up any necessary audio information but will shorten his viewing time. After he has watched about 100 feet of film, the operator may put the machine on high-speed reverse to go back and make his cuts. Since the high-speed reverse on the machine normally will be set for 400 ft/min, he can return to the beginning of the film in only 15 sec. If he does not wish to go all the way back, he can watch the picture in the viewer until he recognizes the point at which he wishes to make his cut. Retreating to that point, he can mark it with a small edge-cutting device in the viewer, move the film forward about $1\frac{1}{2}$ ft until it is just to the right of the sound reader. He will then break the film and thread it onto the take-off reel (lower right of Fig. 3). He will press the take-off switch, put the machine in high-speed forward and watch the viewer until he comes to the end of his cut, whereupon he will stop the machine, splice the free ends of the film together, reset the take-off switch and proceed.

It should be noted that while the Inspect-O-Film Editor was designed primarily for the needs of the TV station, it aids in several other areas of film operations. Among actual applications are: editing of single-system, picture alone or track alone work-print; critical inspection in a film exchange; survey and repair of training films (where high-speed training value evaluation is required); and film repair in a "revitalizing" laboratory.

*Robert Grunwald and Richard Wallace, "Automatic film inspection," *Jour. SMPTE, 66:* 116–118, Mar. 1957.

Some Considerations of Eastman Color Print Film Dye Stability

By PAUL HOROWITZ
and WILLIAM R. WELLER

The dyes in Eastman Color Print Film are quite satisfactory for stability when the film is processed according to recommended procedures. Their stability under conditions of high temperature and high humidity can, however, be seriously affected by retained hypo and/or abnormal pH of the processed emulsion. These conditions can be prevented by following recommended processing procedures, particularly the final wash. A simple method of measuring the emulsion pH directly on the processed film, and emulsion pH control parameters are described.

The problem of maintaining the stability of dyes in color films is one that has received considerable attention from those employed in the design of films and processes. The dyes in color films have been selected for maximum stability consistent with the requirements for their hue and their formation in a photographic emulsion.

Image stability is not a new problem. For a long time, it has been recognized that black-and-white films have required special washing and keeping procedures to maintain their quality for archival purposes.

The stability of dyes used in color films is a much more complicated problem because of the complex nature of the organic materials used as couplers and developers. Since most organic dyes are fugitive, at least to some extent, it should be realized that the excellent stability of the dyes used in color films is indeed somewhat miraculous, and not accidental. The processing procedures recommended by the manufacturer are not devised by happenstance. Each processing step is carefully considered so that the final result will be the best possible dye system for the color film.

When Eastman Color films are processed according to recommendations, they have proved satisfactory to the motion-picture industry under widely varying conditions of use. Several recent cases in which insufficient attention to processing details led to dye fading difficulties prompted this report.

Effect of Film pH and Hypo Retention on Dye Stability

One extremely important detail of a film process that is occasionally overlooked is the final washing. Using a shorter than recommended final wash for Eastman Color Print Film can result in serious dye fading, particularly if the processed film is stored under conditions of high temperature and high humidity. A thorough investigation of these fading phenomena has shown that an inadequate wash can result in a high level of retained hypo and low pH of the emulsion of the processed film (which will be referred to as "film pH"). A relationship has been established between dye fading and the two control parameters, hypo retention and film pH. It has been generally known for some time that a level of retained hypo greater than 0.02 mg/sq in. of film could be detrimental to the stability of the cyan dye. In the Kodak Research Laboratories it was noted that a sample of customer-processed Eastman Color Print Film that showed very serious yellow-dye fading was characterized by low film pH. It was recently established that film pH below a value of 4.2 can be detrimental to the stability of the yellow dye, and pH above a value of 6.0 detrimental to the stability of the cyan dye, when the film is kept under conditions of high temperature and high humidity such as can occur in tropical areas. The keeping conditions of all tests described in this paper were 140 F at 75% relative humidity. These conditions are extremely severe and are intentionally so in order to accelerate the dye changes. Studies have shown that with proper processing, Eastman Color Print Film is quite stable, even under these extreme conditions. Figure 1 demonstrates the results from two frames of the same film, where A was incubated for six days and shows practically no dye change when compared to B, the unincubated frame. Figure 2B illustrates an extreme case of yellow dye fading following six days' incubation. The pH of this frame was intentionally lowered to demonstrate the effect. Comparing it with the normally processed print 2A illustrates this effect. Figure 2C illustrates cyan dye loss resulting from high film pH. This frame was also incubated for six days at 140 F, 75% R.H. This type of fading situation would not normally occur as a result of a short wash, but it could result from treatment of the film in highly alkaline baths which are not followed by acidifying baths to adjust the film pH to the recommended level. Such a situation would be abnormal, but it can occur. The addition of compounds other than Formalin and Photo-Flo to the S-1A stabilizing bath may also affect the film pH adversely.

Figure 2D illustrates a case of cyan dye loss from high hypo retention, which is an effect of insufficient final wash time and/or flow rate. This frame was also incubated for six days.

Hypo Retention and Film pH Control Limits

The control limit for the hypo retention level is a maximum of 0.02 mg/sq in. as determined by Method M.P. 1701C described in the manual entitled "Production of Motion Pictures in Color Using Eastman Color Films." This manual is available from Eastman Kodak Co. through the Motion Picture Film Dept. offices. Control limits for the pH of processed film are 4.2 to 6.0, which is a broad range. The method for measurement of film pH is quite simple and will be published in the near future. Briefly, it consists of the following:

Method of Measuring Film pH: Apparatus consists of a Beckman Model G pH Meter equipped with Beckman electrodes: #1190-80 glass electrode and #1170 calomel electrode. The meter is first zeroed with a 4.01 pH buffer solution, then checked with a 9.18 pH buffer solution. A rubber band is placed around the necks of the electrodes just above the bulb to hold the electrodes close together in order to be able to take the pH measurement on a small area of film; about one-half of a motion-picture frame is the area required. A cardboard strip-holder is used to hold the film. Two drops of distilled water are then applied to the emulsion side of the film with a pipet and the electrode tips are lowered into the pool of water on the film, as shown in Fig. 3. The electrodes need not touch the film directly, although doing so will not affect the result. At the end of 2½ minutes, during which time pH equilibrium is established, the meter is read and pH noted. This method offers adequate precision — a 95% confidence limit of 0.08 pH units under rigorously controlled testing conditions. Because the solutions measured on the film are not highly buffered, the atmosphere must be free of such volatile compounds as ammonium hydroxide, hydrochloric acid, acetic acid, or other compounds that may dissolve in the water droplet and produce erroneous results.

D-Min and D-Max pH Differential

There may be a pH differential of about 0.2 to 0.4 pH units between areas

Presented on May 1, 1957, at the Society's Convention at Washington, D.C., by Paul Horowitz and William R. Weller (who read the paper), Color Technology Div., Eastman Kodak Co., Kodak Park Works, Rochester 4, N.Y.

(This paper was received on October 28, 1957.)

(B), no incubation.

(A), incubated for six days.

Fig. 1. Effect of incubation on dyes of properly processed Eastman Color Print

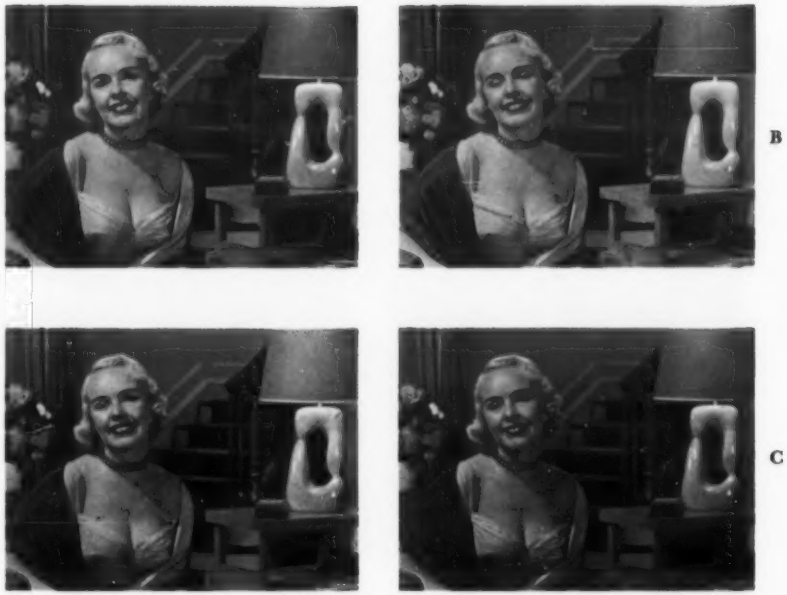


Fig. 2. Effect of incorrect processing on dyes of Eastman Color Print Film; all frames incubated for six days. Top left (A), normal process. Top right (B), yellow dye loss due to low film pH. Bottom right (C), cyan dye loss due to high film pH. Bottom left (D), cyan dye loss due to high hypo retention.

of minimum and maximum density with the maximum density area being the lower. However, in taking film pH measurements of a given scene, the water droplets will normally cover a varied density range, which will effectively minimize or eliminate the pH differential. If the pH measurements are taken on gray scales or other areas of uniform density, it should be realized that this differential in film pH exists. The preferred method would be to take the measurement on a picture area.

Wash Time and Temperature vs. Hypo Retention and Film pH

Our investigation included a study of the effects on film pH and hypo retention levels resulting from variations in the time and temperature of the final wash. Additional washing of dried processed film was also studied.

The graph shown in Fig. 4 illustrates the effect of variations in time and temperature of the final wash. Spray washing was used in the test at a rate known to give efficient washing. Spray washing is usually more efficient than deep-tank immersion washing for a given wash time and temperature. A temperature range from 39 F to 90 F was investigated so that the effects of temperature variations could be firmly established. It is readily evident that the hypo retention level decreases as wash time increases for a given wash temperature, and that the hypo level decreases as wash temperature increases for a given wash time. Although from these data a higher wash temperature appears more effective, it should be emphasized that with the present product, the optimum temperature is still 70 F ± 5°, since higher temperatures are likely to cause reticulation or other undesirable physical effects. Lower temperatures are less efficient, requiring more time for attainment of a satisfactory hypo retention level, and also may lead to undesirable physical effects. The wash water temperatures of some processing laboratories are dependent on the season of the year, with the water temperature varying between 35 F and 90 F from winter to summer. It might be necessary for the wash time in some of these laboratories to be increased in the winter in order to maintain the desired low hypo retention level if it is not possible to heat the water to the recommended 70 F. The Kodak recommendation of an 8-min, 70 F final wash will normally result in a hypo retention level well below the safe tolerance limit.

The graph shown in Fig. 5 illustrates the effect of wash time and temperature on film pH and was run on the same test samples as used for the hypo retention comparison just illustrated. It can be seen that the film pH increases with longer wash time and higher wash temperatures.

Rewashing of Processed Film

Tests run on processed film found to have abnormally low pH and/or high hypo retention levels showed that additional washing could raise the film pH and lower hypo retention to satisfactory levels. This indicates that under emergency conditions, processed film can be rewashed to raise the film pH in order to prevent yellow dye fading and to lower the hypo retention in order to prevent cyan dye fading. Test runs should be made to determine the optimum rewash time which will be dependent upon the past history of the film and the characteristics of the wash system.

Necessity for Adequate Final Washing

A summary of the findings relating dye stability to film pH shows that as the film pH decreased below 4.2, the yellow dye fading was more severe for a given incubation period, and as the film pH increased above 6.0, the cyan dye fading became more severe for a given period. The extremes for both cases are demonstrated in Fig. 2. This illustrates the stability of properly washed film as compared to film that was inadequately washed. Dangerous levels of hypo retention and abnormal film pH have been found in films processed by some commercial laboratories. Accelerated keeping of some of these samples (140 F, 75% R.H.) has resulted in severe dye fading in short periods of time. Although most of these samples have not yet shown dye fading after short-term temperate keeping, experience indicates that long-term keeping of these films at moderate conditions of temperature and humidity could result in dye fading. This fact necessitates serious consideration where processed film will be subjected to long-term keeping for re-release or archival purposes.

Fig. 3. Position of electrodes in water on film for measuring film pH.

Conclusion and Recommendations

Certain types of dye fading on Eastman Color films have been described that were caused by inadequate attention to certain details of the recommended processing conditions, principally washing. Failure to follow other parts of the recommended procedure may also produce undesirable results, including dye fading. Experience indicates that adherence to recommended processing procedures is the greatest single factor in the prevention of dye fading.

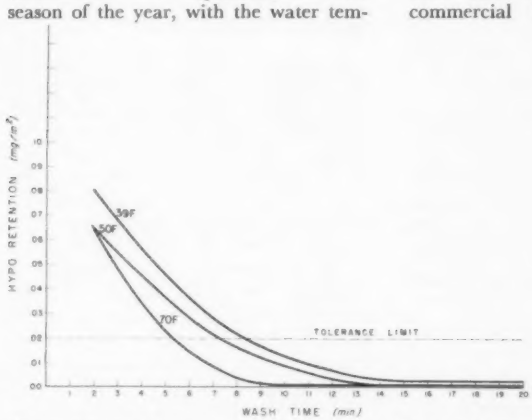


Fig. 4. Effect of time and temperature of the final wash on hypo retention.

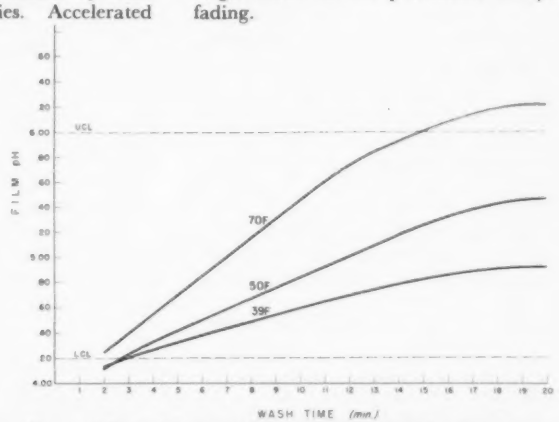


Fig. 5. Effect of time and temperature of the final wash on film pH.

Acknowledgments

P. W. Vittum and D. B. Julian of the Kodak Research Laboratories discovered the effects of film pH on yellow dye stability and developed the analytical method for measurement of film pH in processed film.

Discussion

Herbert Stein (Technicolor of New York Corporation): Could you explain in more detail what you meant by "incubation period," that is, how long, at what temperature and what relative humidity?

Mr. Weller: We kept these at 140 F with a relative humidity, at that temperature, of 75%. These film samples were kept for six days, which is adequate to give us the results we were looking for.

Ralph P. Fernandez (Consolidated Film Industries, Fort Lee, N. J.): Is the effect on negative film the same as you show on positive?

Mr. Weller: No, it is not. We have not studied this completely yet, but it's somewhat different.

Mr. Fernandez: Will this type of dye fading occur in negative and internegative films?

Mr. Weller: The importance of good dye stability characteristics for the valuable negative films is well recognized. We know that the dye stability of Eastman Color Negative and Internegative films is quite satisfactory when the films are processed according to published recommendations. It is obvious that greater attention to all of the processing details is necessary for the production of stable negative films. Storage under conditions of moderate temperatures and humidities is an important factor in maintaining the quality of all processed films.

The dye systems of Eastman Color Negative and Internegative films are somewhat different from that of Eastman Color Print film, so the results of improper processing may be quite different with respect to dye fading. An important processing step in the negative process is the use of the S-3 Stabilizing Bath, which helps maintain proper emulsion pH and assists in the removal of residual hypo. When this bath is used as recommended, excellent dye stability characteristics are obtained in the negative film systems.

A Color Timing Method and Calculator for Subtractive Motion-Picture Printers

By GEORGE T. KEENE

Densities of a gray card held in the key light of each scene provide accurate information for predicting printing packs. This timing method has advantages over the full-frame integrated density method in certain cases. A slide-rule type calculator has been used to predict subtractive printer balances from gray-card densities with a timing accuracy of ±0.03 log E on the first trial in an Eastman Color Negative-Print system. Equations are included for using a matrix calculator for this purpose.

IN PRINTING color motion pictures in a negative-positive system, the object of any color timing system is to utilize information from the negative to make the best possible first print. There are two techniques in this field involving densitometry of the negative, one integrating the full-frame densities and the other reading a gray lily card held in the scene key light. The full-frame density method has been discussed by Stott, Weller, and Jackson* as it applies to additive printing. The system described here is for subtractive printers and utilizes gray lily card readings.

The timing method to be presented in this paper is one designed to give a fairly good color balance for all scenes on the first print. The basis for this method is the assumption that if a common object is correctly placed and photographed in each scene, prints from these negatives will be well balanced if the common object is brought to a constant hue and density in prints from all scenes. A convenient and tested object for this purpose is a gray card.

Theory of Method

The card image obtained on the print film need not be visually or spectrophotometrically "gray," as this criterion might be difficult to specify for all viewers, densitometers or projection conditions. The only requirement in gray-card timing is that the card image on the print film appear in *all* scenes at a *constant* color and density, not necessarily "gray." The choice of this "gray" for a typical scene is left to the timer, but once it is selected, cards in all subsequent scenes must be matched to this same "gray." The original card does not necessarily have to be nonselective, although use of a near-neutral card of medium reflectance will give the highest timing accuracy.

A print made in this manner, i.e., with gray cards in all scenes matched, might be called a sensitometrically correct print. It probably will not be the most pleasing print, but it should be close enough to optimum balance to require only minor changes in some scenes. These final artistic corrections would be made by the timer after viewing the first gray-card timed print.

Comparison With Full-Frame Technique

In the system where full-frame transmittance of the negative is measured, the assumption is made that the average scene will have integrated red, green and blue densities near neutral and that deviations from the average values must be corrected to some degree. The correction level chosen depends on the relative occurrence of scenes having deliberate color distortions, scenes having accidental density shifts, and scenes exhibiting subject failure. Once the correction level is chosen, it is fixed and cannot reasonably be changed without more knowledge of the original than can be obtained from full-frame density readings. The compromise required in the correction level may be of lesser importance in products for amateurs where the tolerances are larger and the subject treatment less critical than in Hollywood productions.

Use of a gray card for color timing will be most advantageous in those scenes exhibiting subject failure; for example, normally illuminated objects photographed against a uniform, brightly colored background. In this situation a full-frame reading system will produce over-correction, while the gray-card timing system, uninfluenced by the colored background, will produce a normal print. If the negative has been affected by abnormal keeping conditions or has been put through a nonstandard process, both timing methods will correct to some extent. The acceptability of the full-frame timed print will depend on how close the assumed correction level has been set to 100%. The gray-card method, however, should give an acceptable print on the first trial.

Limitations of the Method

Any strictly mechanical system will fail to give good results in those situations where deliberate color distortions are present. These occur where colored lights are used on a set or in sunrise and sunset scenes. In these cases, all automatic systems try to correct the desired color out of the scene, thereby producing a more neutral and unacceptable print.

The positioning of the gray card is somewhat critical, particularly in those scenes having high lighting ratios. In general, the gray card should be held very near the principal subject and at such an angle as to reflect the key light toward the camera. The card should have a matte surface to minimize specular reflections. As the lighting ratio in-

Presented on May 1, 1957, at the Society's Convention at Washington, D.C., by George T. Keene, Color Technology Div., Kodak Park Works, Eastman Kodak Co., Rochester 4, N.Y. (This paper was received on June 6, 1957.)

* J. G. Stott, W. R. Weller and J. E. Jackson, "Automatic timing of color negatives," *Jour. SMPTE, 65:* 216–221, Apr. 1956.

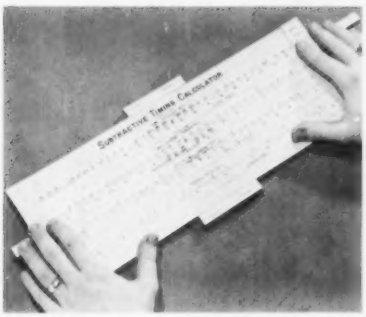


Fig. 1. Subtractive Timing Calculator.

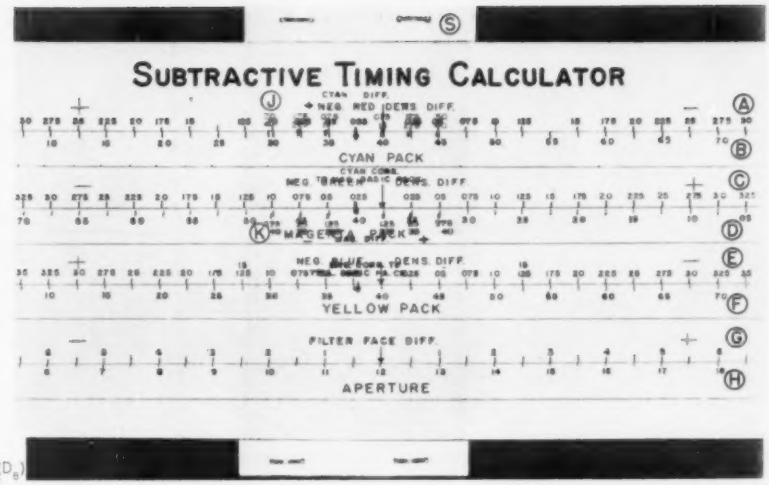


Fig. 2. Subtractive Timing Calculator. Scales B, D, F and H are movable. Scales J and K are on the slider.

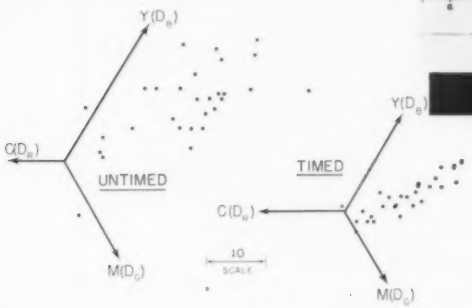


Fig. 3. Trilinear plot showing results of first timing test.

creases and the scene contains more and more side lighting, the card must be turned further and further from the camera axis in order to maintain maximum brightness as seen by the camera. Obviously, the apparent size of the card will decrease as it is turned, making a larger card necessary in these situations to keep a measurable image of the card on the film. In those scenes having true back illumination, the gray-card method cannot be used unless the card is specially lighted to a predetermined "normal" level.

Procedure

The gray-card system was tested with two sets of material. In the first, exposures were made on 29 different coatings of Eastman Color Negative Film, Type 5248, varying in age from fresh to three years old. The variations included differences in both speed and contrast of the film itself and those differences caused by keeping conditions. The second set consisted of a series of exposures made with cyan, magenta and yellow CC filters from 0 to 90† over the camera lens. In both cases, the scene photographed was a normal interior with a gray card that would be at least 5mm square on the negative.

A slide-rule calculator, called the Subtractive Timing Calculator (STC), was designed and constructed to aid in finding the correct filter packs for the printer. The calculator is illustrated in Figs. 1 and 2. The nominal filter values and a straight one-for-one correction for negative density differences were used in the scales.

The timing procedure was as follows:

1. The red, green and blue densities of the gray card on each negative were read on an Eastman Electronic Densitometer, Type 31A using Status K-31 filters.

2. A scene with gray-card densities near the average for the feature being timed was selected and printed onto Eastman Color Print Film, Type 5382, until an optimum print was obtained. The filter pack for this print was made up to include about CC-40*C*, CC-40*M*, and CC-40*Y* to provide a full range for color timing. This optimum balance was put into the STC slide rule as the basic pack.

3. The *differences* in negative density between the gray card of each scene and that of the "average" scene were entered on the STC rule, and the calculated filter balance and printing light for each scene were read from the rule.

Instructions for operating the slide rule are given in the Appendix.

The calculated filter packs for each scene were put into a subtractive color timing printer to make the first print. (An experimental filter-change mechanism was attached to a Bell & Howell Motion Picture Printer, Model D.) The lowest values of *C*, *M*, and *Y* filters used for the group of scenes may be put into a stationary printer pack with only the residual filter differences going into the scene-to-scene timers. This is desirable since it reduces the number of filters handled by the timing mechanism.

Results

First Trial. The gray-card patches on the print were read on the 31A densitometer using Status A-31 filters. The success of the timing system was judged by the amount of difference between the reproduction of the gray card in the various prints and that in the original, average-scene print. The density differences were plotted on trilinear paper. Figure 3 compares data from the first test with similar data from untimed prints.

Although a great improvement was effected over the untimed print, there obviously remained a sizable error along the red-yellow, blue-cyan axis. It was thought that this error was due to unwanted absorptions in the filter dyes, and a slider was constructed for the rule to account for these difficulties. The basis for making the slider is explained in the Appendix. A reprint, however, made using the correction for unwanted absorptions, failed to show much improvement.

Adjustment of Scales. It was next decided to make the STC scales nonlinear, if necessary, in order to bring the print

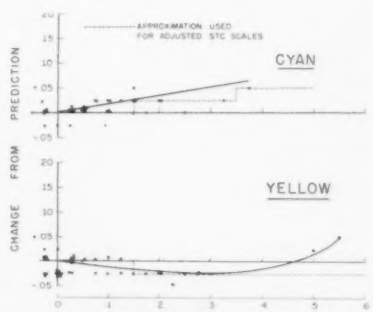


Fig. 4. Graphs used for determining adjustment to STC scales to compensate for deviations of filters from nominal values.

† CC filters will be designated according to density; see the Appendix.

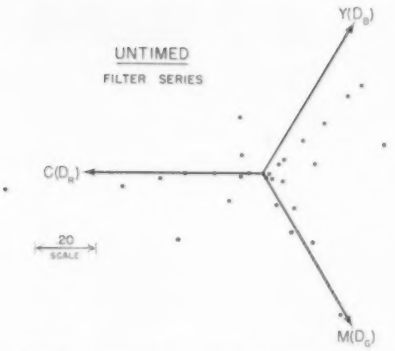


Fig. 5. Trilinear plot of data from untimed filter series.

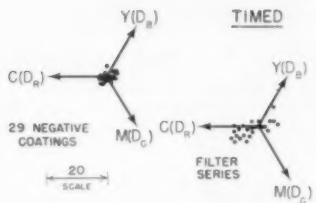


Fig. 6. Trilinear plot of timed prints from filter series and from coating series.

patches to a common balance. Such action would be required if the CC filters used do not conform exactly to their nominal values. This was found to be the case both from the printing results and by densitometry of filters. Both sources of data showed the denser cyan filters to be slightly less dense to red light than the nominal values. The magenta filters were reasonably good, but the yellow filters showed first a rise in density above their nominal values and then a tendency to decrease slightly after the 0.30 level.

The shift in the STC scales to compensate for the lack of conformity to nominal values was calculated by plotting the differences between the original predicted pack and the actual pack required to get a balanced print, against the value of the original predicted pack (see Fig. 4). The best line through the plotted points is straight for the cyan and curved for the yellow data. Much of the scatter of the points is due to the need to use discrete filter increments in timing. The dotted lines show the approximation of the data built into the STC scales.

The second negative original (camera CC filter series) was used for testing the adjusted scales. The data from the untimed print from this original are plotted in Fig. 5. Data from the print made using the slide-rule calculator are shown in Fig. 6. As a further check, the first original (29 negatives) was timed and printed, and these results are also shown in Fig. 6.

It should be noted that Figs. 5 and 6 are plotted to *one-half the scale* used for Fig. 3 so as to include all the points for the untimed prints. The negative density range produced by the filter series was much greater than that from the coating series.

The cluster of points from the timed filter series (Fig. 6) is not as compact as that from the 29-negative series, although both show much less spread than the points for the untimed prints. Both plots from the timed prints still show an elliptical shape along the red-yellow, blue-cyan axis, but this tendency is less than in Fig. 3. Table I summarizes the precision of the prints.

An illustration of the results is shown in Figs. 7 and 8. Frames from both untimed and the final, timed, filter-series prints are shown.

Variations in Print Film or Printer. Any negative timing system assumes an unvarying print film, printer and print process. Little can be done about a process shift, but a change in print film or printer output can be measured and allowed for in printing. To change from one print-film emulsion number to another, for instance, the speed differences between the present and new emulsions are determined either from sensitometer or printer exposure tests, usually at a density near 1.0. This speed difference (for each color) is converted directly to filter density differences, which are then inserted in the STC basic pack. Timing for each scene then proceeds as before.

In a trial of this procedure it was found that prints on two coatings could be brought within 0.02 log E of each other for color balance and to the same overall density level.

Practical Picture Tests. The previous data have shown that with the gray-card system and the STC rule, a negative whose balance is distorted by filters or emulsion changes can be timed to a preselected balance. However, successful timing of picture prints would depend on how well the original assumption of constant, gray-card density and color balance was borne out in actual practice. For a picture test of the system, a number of scenes were shot including indoor, outdoor, high-key, and low-key sets. In all scenes, a gray card was held for a few seconds in the key light and close enough to give a 5mm square on the film.

The full-length, 910-ft roll contained 49 scenes including numerous coatings and deliberate exposure errors. Untimed and STC-timed prints were made, and a trilinear plot of the gray-card densities of the prints, for the untimed and the STC-timed prints, is shown in Fig. 9. The variation in green density for both sets of prints is shown in Fig. 10. The gray-card densities of these timed prints varied somewhat more than in the previous tests, but the scenes in general were judged by most viewers to be well timed for a first balance. Low-key and subject-failure scenes were particularly good considering the usual difficulties in printing such scenes on the basis of full-frame readings.

The gray-card timing method can easily be applied to additive printing. The calculator necessary for additive-printing work would be less complicated in design and easier to use than the one just described.

Possibility of Machine Calculation

If all the corrections built into the STC calculator are assumed to be linear, rather simple equations can be written describing the operation of the filter scales on the calculator. These will have the form:

$$\begin{aligned} C &= C_{BP} - a\Delta D_R \\ M &= M_{BP} - b\Delta D_G + d\Delta D_R \\ Y &= Y_{BP} - e\Delta D_B + f\Delta D_G \end{aligned} \qquad (1)$$

where C_{BP}, M_{BP} and Y_{BP}, are the basic packs for the average scene and $\Delta D_{R,G,B}$ are the density differences between the negatives of the particular scene and the average scene. The constants in these equations (a,b,d,e,f) are found from the graphs in Fig. 4 and from the filter data used to build the slider scales. The resultant equations are:

$$\begin{aligned} C &= C_{BP} - 1.16\ \Delta D_R \\ M &= M_{BP} - \Delta D_G + 0.19\ \Delta D_R \\ Y &= Y_{BP} - 0.92\ \Delta D_B + 0.12\ \Delta D_G \end{aligned} \qquad (2)$$

Table I. Variation in Print Patches.

	Print Density Spread (Long Axis of Ellipse)	Equivalent Log E Variation in Timing (Long Axis of Ellipse)	(Short Axis of Ellipse)
Untimed, *Fig. 3*	±0.24	±0.12	±0.05
Timed, *Fig. 3*	±0.11	±0.05	±0.015
Untimed, *Fig. 5*	±0.86	±0.43	±0.19
Timed filter series, *Fig. 6*	±0.09	±0.05	±0.02*
Timed 29-negative series, *Fig. 6*	±0.04	±0.02	±0.01

* The values in the box represent the best precision to date and probably cannot be improved upon in subtractive printing. Data on filter uniformity show variations nearly equal to the values listed.

Fig. 7. Color range obtained in untimed prints of the filter series.

Fig. 8. Results obtained by timing using the STC calculator.

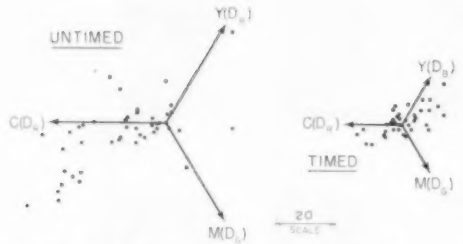


Fig. 9. Trilinear plot of data from untimed and timed prints of 49-scene picture test.

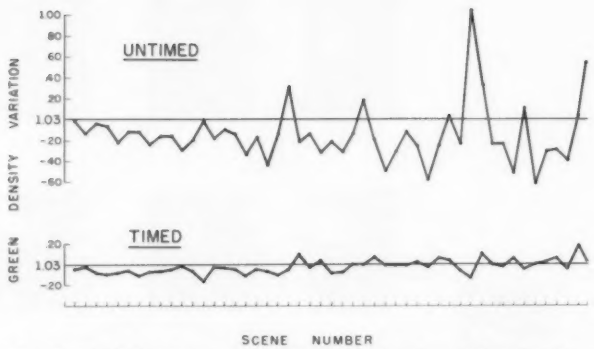


Fig. 10. Variation in green density of untimed and timed prints from picture test.

These equations agree reasonably well with the following ones predicted theoretically by Pinney and Weller.‡

$$\begin{aligned} C &= C_{BP} - 1.08\,\Delta D_B \\ M &= M_{BP} - \Delta D_G + 0.22\,\Delta D_R \\ Y &= Y_{BP} - 1.08\,\Delta D_B + 0.14\,\Delta D_G \end{aligned} \quad (3)$$

Although use of the STC rule is fairly quick and simple, there remains room for errors in operation. These errors could be minimized if a calculator set up on equation set (2) were available. Such a machine would be similar to calculators already built in the Eastman Kodak Co. for other purposes. The correct printer aperture could be manually selected quickly once the new filter packs are available.

APPENDIX

Operation of the STC Color Timing Scale

The steps prior to the use of the slide rule have been described in the paper and are outlined briefly below:

1. Read through Status K-31 filters the R, G, and B negative densities of the gray card areas.

2. Pick any "average" scene and print to an optimum balance. The filters used to arrive at this balance form the basic pack for all STC calculations. This pack should contain about CC-40C, CC-40M, and CC-40Y filters.

3. Find the difference in negative density of the gray patch between each scene and the "average" scene.

The following steps explain how negative density differences are used to predict printer packs using the calculator. The slide rule is illustrated in Fig. 2 and shown in perspective in Fig. 1.

1. Scales B, D, F and H are movable; on these scales are found the three filter-pack components and the printer aperture. The fixed scales A, C, E and G locate the differences in negative densities and in the number of filters in the pack. The slide (S) is of clear Kodapak and indicates in scales J and K corrections for unwanted absorptions of the filters.

2. In use, scales B, D, F and H are set so that values for the basic pack for the "average" scene fall under the reference arrows in the center of scales A, C, E and G. If there were no unwanted filter absorptions, the new packs could simply be read off for each negative density difference. However, changes in the cyan filter pack affect not only the red-light log E but also the green-light log E. Also, magenta filter shifts move the blue-light exposure as well as the green. Fortunately, the blue-light absorption of the magenta filters are negligible. The yellow filters have only blue-light density. These unwanted filter absorptions are compensated by shifting the midscale reference arrows by the amounts indicated on the slider. Changes in the cyan pack affect the green reference arrow (scale C) while changes in the magenta pack affect the blue reference arrow (scale E).

3. The calculation of a new pack is best shown by the following illustration:

	Negative Densities "Average Scene"	*New Scene*	*Difference*	*Pack for Average Scene*
R	0.70	0.57	−0.13	2B + 40C + 40M + 40Y at Aperture 12
G	1.15	1.30	+0.15	
B	1.90	1.80	−0.10	

4. The new cyan pack is 525§ as read under the −125 mark on scale A.

5. The scales and slider in Fig. 2 are shown as set at the end of the following calculation.

The new magenta pack, if read directly from scale C at +15, would be 25. However, the green-light absorption of the 125 cyan shift must be accounted for, and this is done by moving the slider until the "Cyan Diff." $\frac{-075}{15}$ mark on scale J is over the central reference arrow on scale A. The red slider arrow labeled "Cyan Correction to Magenta Basic Pack" then indicates the point to which the 40 on the magenta pack scale D must be moved. The correct magenta pack (225) is then read on scale D directly below the +15 on scale C.

The basic pack (40) on scale D should be reset to the central black arrow on scale C before the next calculation.

6. The new yellow pack would ordinarily be 50, but this must be corrected for the blue-light absorption of the magenta correction. The "Mag. Diff." $\frac{+125}{225}$ mark on the slider scale K is moved under the central reference arrow of scale C. The 40 on scale F is then moved to the left below the red slider arrow labeled "Magenta Correction to Yellow Basic Pack." Now the new yellow pack, 525, is read on scale F below the −10 mark on scale E.

7. The number of filters in the calculated pack is now compared with that in the basic pack and the printer aperture found:

	Basic Pack	*New Pack*
Filters	2B + 40C + 40M + 40Y	2B + 50C + 025C + 20M + 025M + 50Y + 025Y
No. of Filters	4	7
Filter Difference (New-Basic)		+3
Basic Pack Aperture	12	
New Pack Aperture		15

One printer light is allowed for each increase or decrease in number of filters. This calculation can usually be done quickly without the use of scales G and H. The largest values of filters should always be used in making up a given pack, i.e., CC-40 rather than two CC-20 filters.

8. Although the preceding seven steps sound involved and are difficult to describe, the actual calculation of packs can be done at the rate of two per minute, once the negative density differences are in hand. Very little practice is required to achieve this speed using the STC.

‡ J. E. Pinney and W. R. Weller, "Calibration of color motion-picture printers," *Jour. SMPTE, 65:* 485–487, Sept. 1956.

§ In this discussion three-digit numbers are used where necessary to describe filter packs containing CC-025 filters, i.e., 525 equals CC-50 + CC-025; 275 equals CC-20 + CC-05 + CC-025.

Seven American Standards

Published on the following pages are seven American Standards, which include revisions of three existing standards, approved by the American Standards Association on May 2, 1958:

PH22.28-1958 Focal Lengths and Markings of 35mm Motion-Picture Projection Lenses (Revision of Z22.28-1946)

PH22.73-1958 Dimensions for 35mm Motion-Picture Film, Perforated 32mm, 2R-2994 (Revision of PH22.73-1951)

PH22.87-1958 100-Mil Magnetic Coating on 16mm Film, Perforated One Edge (Revision of PH22.87-1953)

PH22.89-1958 Scene-Change Cueing for Printing 16mm Motion-Picture Film

PH22.108-1958 Four Magnetic Sound Records on 35mm Film

PH22.111-1958 Picture and Sound Apertures for Continuous Contact Printers for 35mm Release Prints With Photographic Sound

PH22.112-1958 Picture-Sound Separation in 16mm Magnetic Sound Projectors

A history of the development of the above-mentioned standards accompanied their trial publication in the *Journals* indicated below:

PH22.108 — January 1957
PH22.73 and PH22.87 — February 1957
PH22.111 — March 1957
PH22.89 and PH22.112 — April 1957
PH22.28 — May 1957

All but three standards, PH22.28, -.87 and -.112, have been modified since their trial publication. PH22.73 has been changed considerably to bring it into conformance with other film dimension standards. Paragraph 1.1 of PH22.108 has been modified for clarification of scope and paragraph 1.3 of PH22.111 is an addition to the scope not appearing in the previously published proposal. The millimeter value for dimension C in PH22.89 has been rounded off to be consistent with other standards. — *J. Howard Schumacher, Staff Engineer*

American Standard

Focal Lengths and Markings of 35mm Motion-Picture Projection Lenses

ASA Reg. U.S. Pat. Off.
PH22.28-1958
Revision of Z22.28-1946
*UDC 778.55

1. Scope

1.1 This standard specifies for the lenses used in 35mm motion-picture projectors:

(1) The increments in the focal length of lenses up to 7 inches in focal length (see Appendix).

(2) The permissive tolerance between actual and designated focal length.

(3) The marking on the lenses.

2. Focal Length

2.1 The focal length of lenses up to 7 inches shall increase in ¼-inch steps (see Appendix for increments above 7 inches).

2.2 The actual focal length shall not differ from the value marked on the lens by more than ± 1 percent.

3. Marking

3.1 The focal length of the lens shall be marked on the lens barrel.

APPENDIX

(This Appendix is not a part of the American Standard Focal Lengths and Markings of 35mm Motion-Picture Projection Lenses, PH22.28-1958, but is included to facilitate its use.)

Practices on lenses greater than 7 inches in focal length differ with the different manufacturers. The increments are either ¼-inch or ½-inch steps, depending on the manufacturer.

Approved May 2, 1958, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

70 East Forty-fifth Street, New York 17, N.Y.
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ASA\$/M650
Price, 25 Cents

American Standard

100-Mil Magnetic Coating on 16mm Film, Perforated One Edge

ASA Reg. U.S. Pat. Off.
PH22.87-1958
Revision of PH22.87-1953
*UDC 778.554.4

1. Scope

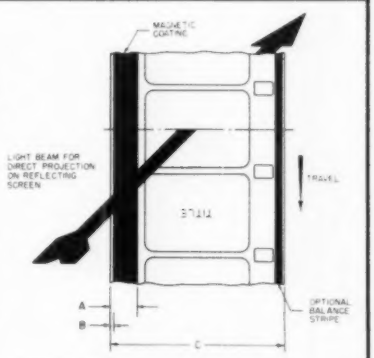
1.1 This standard specifies the location and dimensions of the magnetic coating applied to 16mm motion-picture film with perforations along one edge. This film is used for both picture and sound.

2. Dimensions and Location

2.1 The dimensions shall be as given in the diagram and table.

2.2 The magnetic coating shall be on the side of the film toward the lamp on a projector arranged for direct projection on a reflection-type screen.

NOTE: The balance stripe is optional and may be a magnetic coating or another material of the same thickness.



Dimension	Inches	Millimeters
A	$0.100 \begin{smallmatrix}+0.005\\-0.000\end{smallmatrix}$	$2.54 \begin{smallmatrix}+0.13\\-0.00\end{smallmatrix}$
B	0.005 max	0.13 max
C	0.628 nom	16 nom

Approved May 2, 1958, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

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American Standard

Dimensions for 35mm Motion-Picture Film, Perforated 32mm, 2R-2994

ASA
Reg. U.S. Pat. Off.
PH22.73-1958
Revision of PH22.73-1951
*UDC 778.58

1. Scope

1.1 This standard specifies the dimensions of 35mm motion-picture film having two rows of 16mm type perforations, one near each edge of the 35mm film.

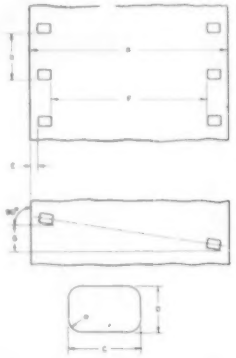
2. Dimensions

2.1 The dimensions shall be as given in the diagram and table.

2.2 These dimensions pertain to a safety film with low-shrinkage characteristics as defined in Appendix 2.

2.3 These dimensions apply to material immediately after cutting and perforating.

2.4 Dimension L represents the length of any 100 consecutive perforation intervals.



Dimension	Inches	Millimeters
A	1.377 ± 0.001	34.98 ± 0.03
B	0.2994 ± 0.0005	7.605 ± 0.013
C	0.0720 ± 0.0004	1.829 ± 0.010
D	0.0500 ± 0.0004	1.270 ± 0.010
E	0.096 ± 0.002	2.44 ± 0.05
F	1.041 ± 0.002	26.44 ± 0.05
G	0.001 max	0.025 max
L	29.94 ± 0.03	760.5 ± 0.8
R	0.010 ± 0.001	0.25 ± 0.03

NOTES

1. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard Inch-Millimeter Conversion for Industrial Use, B48.1-1933, reaffirmed 1947, providing a conversion factor of 1 inch = 25.4 millimeters.

2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

3. The fundamental difference between this standard and its 1951 predecessor is in the decrease in the values for dimensions B and L, which were specified respectively as 0.3000 ± 0.0005 inch and 30.00 ± 0.03 inch.

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Sponsor: Society of Motion Picture and Television Engineers

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ASA\M658

Price, 25 Cents

APPENDICES

(These Appendices are not a part of American Standard Dimensions for 35mm Motion-Picture Film, Perforated 32mm, 2R-2994, PH22.73-1958, but are included to facilitate its use.)

APPENDIX 1

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions and tolerances are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the slitters, punches and dies. Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These changes invariably result in changes in the dimensions during the life of the film. The change is generally uniform throughout a roll.

APPENDIX 2

For the purpose of this specification, low-shrink film base is film base which, when coated with emulsion and any other normal coating treatment, perforated, kept in the manufacturer's sealed container for six months, exposed, processed and stored exposed to air having a temperature of 65 F to 75 F, 18 C to 24 C, and a relative humidity of 50 percent to 60 percent, for not more than 30 days, and measured under like conditions of temperature and humidity, shall have shrunk not more than 0.2 percent from its original dimension at the time of perforating.

APPENDIX 3

This kind of 32mm film is made on 35mm stock so that it may be processed on 35mm sprocketless developing machines. It is designed for use in intermediate stages in the making of 16mm prints.

APPENDIX 4

To comply with 2.2 this film is made on safety base complying with American Standard Specifications for Safety Photographic Film, PH1.25-1956. Nitrate film should not be used because this film may be slit to the 16mm width and used on 16mm projectors with subsequent danger of fire.

APPENDIX 5

Films which after processing are intended to pass through a continuous contact printer in which the exposure is made over a cylindrical surface do not yield prints of maximum steadiness unless the actual pitch of the film curved to the smaller radius (the "negative") is slightly less than that of the film curved to the larger radius (the "print stock"). Since positive films in general are perforated to a nominal 0.3000-inch pitch and since negative-type films with low-shrinkage characteristics do not shrink enough for optimum pitch relationship with such positive films, the nominal 0.2994-inch pitch was developed for films to be used primarily as negatives for the subsequent production of prints. They also find other specialized uses.

APPENDIX 6

The uniformity of pitch, margin and hole size (dimensions B, C, D and E) is an important variable affecting steadiness. Variations in these dimensions, from roll to roll, are of little significance compared to variations from one sprocket hole to the next. Actually it is the maximum variation from one sprocket hole to the next within any small group of consecutive perforations that is important.

American Standard

Scene-Change Cueing for Printing 16mm Motion-Picture Film

ASA Reg. U.S. Pat. Off.

PH22.89-1958

*UDC 778.58

1. Scope

1.1 This standard specifies the dimensions, location and nature of a scene-change cueing spot for actuating the printer light-change mechanism when printing 16mm motion-picture film.

1.2 This standard is applicable to 16mm film with perforations along either one or both edges. The dotted perforations in the diagram indicate the edge which varies in this respect.

2. Dimensions and Location

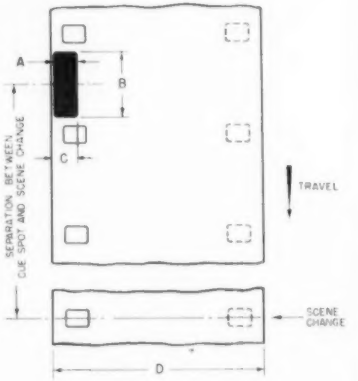
2.1 The dimensions and location of the cueing spot shall be as given in the diagram and table.

2.2 The cueing spot shall be placed 12½ frames after the scene change with respect to the direction of film travel through the printer

2.3 The cueing spot shall be placed on the emulsion side of the film.

3. Nature of Cueing Material

3.1 The cueing spot shall consist of an adhesive-backed metallic foil rounded at all four corners.



Dimensions	Inches	Millimeters
A	0.070 max 0.065 min	1.78 max 1.65 min
B	0.225 max 0.190 min	5.72 max 4.83 min
C	0.080 max 0.075 min	2.03 max 1.91 min
D	0.628 nom	16 nom

Approved May 2, 1958, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

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ASA3M58

Price, 25 Cents

American Standard

Four Magnetic Sound Records on 35mm Film

ASA Reg. U.S. Pat. Off.

PH22.108-1958

*UDC 778.534.4

1. Scope

1.1 This standard specifies the locations and dimensions of four magnetic sound records on 35mm magnetic film, as determined by the lateral dimensions and position of the magnetic recording head.

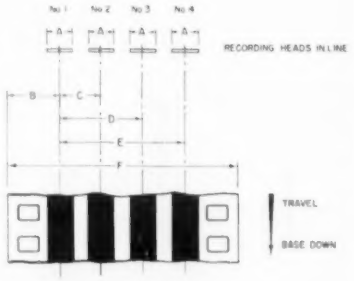
1.2 This standard relates the placement of the magnetic coating on the film to the direction of film travel.

2. Dimensions

2.1 The dimensions shall be as specified in the diagram and table.

3. Magnetic Coating

3.1 With the direction of film travel shown in the diagram, the magnetic coating shall be on the upper face of the film base.



Dimension	Inches	Millimeters
A	0.154 max 0.150 min	3.91 max 3.81 min
B	0.314 ± 0.002	7.98 ± 0.05
C	0.250 ± 0.002	6.35 ± 0.05
D	0.500 ± 0.002	12.70 ± 0.05
E	0.750 ± 0.002	19.05 ± 0.05
F	1.378 nom	35.00 nom

Approved May 2, 1958, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

70 East Forty-fifth Street, New York 17, N.Y.
Copyright 1958 by the American Standards Association, Incorporated
Printed in U.S.A.
ASA3M58

Price, 25 Cents

American Standard

Picture and Sound Apertures for Continuous Contact Printers for 35mm Release Prints with Photographic Sound Records

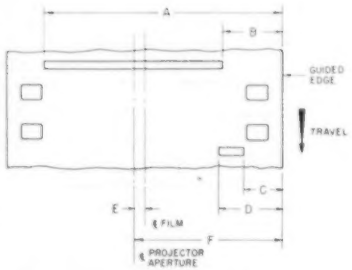
ASA
Reg. U.S. Pat. Off.
PH22.111-1958
*UDC 778.534.4

1. Scope

1.1 This standard specifies the location and width dimensions of the picture and the sound apertures of continuous contact printers for making 35mm release prints with photographic sound records.

1.2 This standard is applicable to the printing of motion-picture raw stock film which is cut and perforated in accordance with American Standard Dimensions for 35mm Motion-Picture Positive Raw Stock, PH22.36-1954, or the latest revision thereof approved by the American Standards Association, Incorporated.

1.3 This standard refers to the adjustment of the printer, and is in accordance with American Standard Photographic Sound Record on 35mm Prints, PH22.40-1957.



AS SEEN FROM THE EMULSION SIDE OF PRINT

2. Dimensions

2.1 The dimensions shall be as specified in the diagram and Table I.

Note: The centerline information given in Table II is not part of this standard and is provided as a convenient reference. These two dimensions are specified in American Standard Aperture for 35mm Sound Motion-Picture Projectors, PH22.58-1954.

Dimensions	Inches	Millimeters
A	1.184 ± 0.002	30.07 ± 0.05
B	0.304 ± 0.002	7.72 ± 0.05
C	0.192 ± 0.001	4.88 ± 0.03
D	0.308 ± 0.002	7.82 ± 0.05

Table 1

Dimensions	Inches	Millimeters
E	0.049	1.24
F	0.738 ± 0.002	18.75 ± 0.05

Table 2

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Price, 25 Cents

American Standard

Picture – Sound Separation in 16mm Magnetic Sound Projectors

ASA
Reg. U.S. Pat. Off.
PH22.112-1958
*UDC 778.554.4

1. Scope

1.1 This standard specifies the picture-sound separation of 16mm motion-picture film with perforations along one edge and with a magnetic sound record on a 100-mil width magnetic coating. (The magnetic coating is specified in American Standard Dimensions for 100-mil Magnetic Coating on Single-Perforated 16mm Motion-Picture Film, PH22.87-1953, or the latest revision thereof approved by the American Standards Association, Incorporated.)

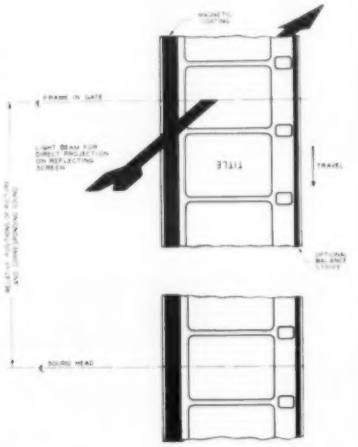
1.2 This standard specifies the location of the magnetic reproduce head in the projector.

2. Picture-Sound Separation

2.1 The magnetic sound record on the film shall precede the center of the corresponding picture by a distance of 28 frames.

3. Location of Magnetic Reproduce Head

3.1 The magnetic reproduce head shall be located 28 frames ahead of the picture aperture as measured with a film threaded in the projector in a normal manner. Thus, at any instant the sound corresponding to the picture frame being projected at that moment shall be reproduced from a point on the film which has passed the picture aperture 28 frames previously.



APPENDIX

(This Appendix is not a part of the American Standard Picture-Sound Separation in 16mm Magnetic Sound Projectors, PH22.112-1958, but is included to facilitate its use.)

When the projector contains an optical-photographic sound-reproduce system with the optical scan point 26 frames ahead of the picture aperture, the magnetic reproduce head is located two frames more distant from the picture aperture. Thus, a given point of the film will pass the optical scan point before reaching the magnetic head.

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Price, 25 Cents

Convention Plans and Other Prospects

By BARTON KREUZER,
SMPTE President

BY A HAPPY COINCIDENCE, it was 63 years ago today that the first exhibition of a projected motion picture took place. On a Sunday afternoon, April 21, 1895, Woodville Latham demonstrated an enlarged Kinetoscope to a group of reporters. Instead of viewing the motion picture through a lens set in a peep hole, like earlier systems, the picture was presented by transmitted light on a screen. Although this invention was at best a crude device, it did represent the first expression of a move toward the screen. The industry has come a long way since then and the Society of Motion Picture and Television Engineers has been an important factor in its progress for the past 42 years. Recognition of these years of service to the Motion Picture Industry by the members of the Society was exemplified in the recent Academy Award voted to our Society by the Board of Governors of the Motion Picture Academy of Arts and Sciences. Although I had the pleasure, on your behalf, of receiving the "Oscar" from the lovely Bette Davis, it is your award and is here for you to see before it is suitably mounted at Headquarters.

It is a custom of our Society that your President, during the Get-Together Luncheon of each Convention, inform you of the Society's accomplishments since the last meeting and discuss with you our plans for the future.

Since our last meeting there have been some important events. A matter of considerable interest to our membership is our Conventions. Last year, in the July 1957 issue of the *Journal*, an open letter presented factors bearing upon the question of possible changes in the Convention procedure of the Society.

Convention Planning Study

At the suggestion of the Board of Governors, an Ad Hoc Committee on Convention Planning was appointed under the chairmanship of Past-President Loren Ryder. Eleven members, representing a broad geographical distribution, were appointed. Loren Ryder and his Committee deserve great credit for having performed a large task in a relatively short time. The Committee's work involved a vast amount of correspondence and an evaluation of many viewpoints.

The purpose of the Committee was to determine whether it would be in the best interests of the Society to have only one Convention a year, or to have some arrangement of one large and one small Convention a year. During the deliberations of the Committee, a questionnaire was first sent to the members of the Committee, then revised and circulated to persons who had attended one or more of the last three Conventions. Of the 585 questionnaires mailed, 279 were returned. After examination of the returns and due deliberation by the Board of Governors, it was decided that, for the benefit of the membership, equipment exhibitors and the industries we serve, the following plan should be adopted:

There will be two Conventions a year, one of which will include an Equipment Exhibit. This may be either in the Fall or the Spring, depending upon geographical and other factors. The second Convention generally will have a five-day schedule, generally will have social events and usually will not have an Equipment Exhibit unless desired by equipment exhibitors because of geographical or other special factors.

Such a procedure provides the change apparently desired by the majority and will afford considerable flexibility until further experience is gained. This plan will not, of course, make any radical change in Conventions scheduled for the next several years. In reality, it is an affirmation of the procedure recently followed.

New Society Groups

At this time, it is fitting that we welcome the newest addition to our Society, the Nashville Section. This new Section was approved by your Board of Governors on April 19. There are now 10 Sections of the Society, and 5 Student Chapters, including the new one at the University of Miami. With the help of our Sections Vice-President Ed Stifle, we are keeping pace with our past record of expansion and making gratifying progress in the furtherance of our aim of interesting young people at the college level in careers in our industries.

Society Operations

At this point it is fitting that I acknowledge and thank Executive Vice-President Norwood Simmons and Convention Vice-President Carl Hunt for their magnificent contributions to me of time, effort and intelligence in connection with this Convention. This has been particularly helpful to me because of the distance involved.

The contributions of the Education Committee are of great importance. Under the watchful eye of Past-President John Frayne, ably assisted by Subcommittee Chairmen Sid Solow, Ed Benham and Lorin Grignon on the West Coast, and Vice-Chairman Herb Barnett and Subcommittee Chairmen J. W. Kaylor and Ed Schuller on the East Coast, a total of three courses for technicians were conducted during the past winter.

At the same time, the engineering committees, under the guidance of Engineering Vice-President Axel Jensen, have been particularly active. This week there will be 11 committee meetings. During the past year, no fewer than 35 standards were in various stages of preparation for submission to the American Standards Association.

More visible to most of us is the continued growth of the Society's publications under the guidance of Editorial Vice-President Glenn Matthews, the Board of Editors and the Papers Committee. The editorial content of the *Journal* has been increasing both in quantity and quality, while our "book dividend" to members, *Elements of Color in Professional Motion Pictures*, represents a very considerable achievement and much effort on the part of numerous authors and editors captained by our Society's Secretary, Bill Holm. At the Winter Board

Presented at the Get-Together Luncheon on April 21, 1958, at the Society's Convention at Los Angeles.

of Governors' Meeting, approval was secured to print a much-needed volume on "Film Laboratory Processing Control of Black-and-White Films," probably for release in 1959.

In recent months, Editorial Vice-President Glenn Matthews has invited prominent members of the motion-picture and television industry in 19 countries of the world, other than our own, to act as National Regional Chairmen or the Papers Committee. Since 17 of these have already accepted, representing countries in the Western Hemisphere, Europe, Asia and Australasia, our Society is increasingly assuming an international character. This action should not only result in a wealth of valuable papers for our *Journal*, but also it will help build support for our Spring 1959 Convention in Miami, which is intended to stress the international facets of our business.

As you know, the burden of management of the Society's financial affairs falls to our Financial Vice-President. Included are the investment of funds, guidance to Headquarters, and many other facets. Our good record in this department in recent years is due in very great measure to Jack Servies' efforts on our behalf.

Accomplishments of this character have, of course, not only benefited the members of the Society, but the industries with which we are associated. They have been helpful to Chairman Ed Warnecke of the Membership Committee and his associates in securing new members, as well as to Treasurer Reid Ray who, in his capacity as Chairman of the Sustaining Membership Committee, has kept the interest of the sustaining members high. Reid reports that last year 13 new sustaining members joined the Society.

The last time we met here — some 18 months ago — papers on video magnetic tape recording equipment for television were presented. Since then, a considerable amount of this type of equipment has been placed in daily use in this country. Here in Hollywood, the additional dimension of color has been added to this equipment. Currently, it appears that this important system of picture recording may be a bridge between the several industries in which the members of our Society are interested.

You will remember, I'm sure, the interest aroused by papers on closed-circuit television and related topics at both the Philadelphia Convention last Fall and at the Washington Convention preceding it. At both of these Conventions, papers were also presented on missile photography and instrumentation. No sooner were the words out of our mouths, than came the Sputniks, the Explorers and the Vanguard — and since then even the comic strips have been forecasting a marriage of these several skills in reconnaissance satellites. Obviously, the challenge to technical and scientific abilities is ever increasing in an almost limitless upward spiral. This offers additional opportunities to be of service to our members and augurs well for the future of our Society, if we continue to retain a broad outlook, individually and collectively.

Through the painstaking efforts of Program Chairman Herb Farmer and his Committee, the 83d Convention Program is a substantial one comprised of 15 sessions containing a total of 82 papers and special presentations on many diverse subjects, [which will be reported in a forthcoming issue of the *Journal*].

Much credit and thanks for the effective planning and operation of this Convention in the usual efficient "Hollywood manner" are due our Local Arrangements Chairman, the Chairman of the Hollywood Section, Jack Duval, and the many Chairmen of Convention Committees cited in the Program [and in the February *Journal*].

An integral part of this Convention is an Equipment Exhibit organized by John Olsson. It is outstanding in our history for its scope and interest.

A Writer–Producer Looks at SMPTE

By CHARLES BRACKETT

(*These are excerpts from the remarks at the April 21, 1958, Get-Together Luncheon, by Mr. Brackett who has been writing for motion pictures in Hollywood since 1934 and has produced a score of distinguished films, including* The Lost Weekend *and most recently* Ten North Frederick.)

OVER AND OVER again your members have contributed minor miracles to pictures I have written or produced. They range all the way from the small nightmare of a fight between a bat and a mouse to the somber magnificence of the sinking of the Titanic. . . .

The late Terry Ramsaye wrote, "Showmen are never inventors and inventors are rarely showmen. Showmanship is ever concerned with exploiting the status quo and things in hand. Inventors are not concerned with the status quo or the things in hand." It is you to whom the industry must turn when it has grown a little drowsy sitting on its status quo. How often have you saved the industry from terrible doldrums with some brilliant new concept of picture presentation! Once, briefly, it was 3-D, then CinemaScope, then Todd-AO. Always, you fellows in the motion-picture branch of your organization have come charging up like gang-busters and vanquished the doldrums and saved the day.

But we must face the fact that the members of the other half of your schizoid organization contributed just a mite to the doldrums with that contraption which turns out to be Everyman's own projection room. It is my projection room, too, and I enjoy it thoroughly, but let me confess that there have been times when I, as a theater-type movie-maker, have considered making this low appeal to you: You are great inventors, you must be proud of the stunts you can perform. How about doing the greatest stunt of all? How about using your talents to un-invent something? And you know what I mean by "something!"

But this is just Mr. Ramsaye's showman longing for a vanished status quo. Believe me, I wouldn't have it back if I could. Television has been the healthiest thing that ever happened to motion pictures. It has demanded a new excellence and has sky-rocketed the drawing power of a great picture; it has increased the grosses of such pictures unbelievably. It is a wise thing to ride with the wave of the future. . . .

Both Government and private corporations have acknowledged their debt to you. Developments in such areas as undersea and aerial photography, the psychological uses of color and sound, the refining of old techniques to meet new conditions, the standardization of equipment — all these bear witness to the scope of your enterprise. . . .

Your plans for the future include projects more intricate and varied than the most rabid science fiction fan could envision, and their effects will be global. In your March *Journal*, for instance, there were five papers on international television and multilingual films. The technical problems involved are complex almost beyond description. Their solution offers possibilities that the arts will be so expanded in the foreseeable future that understanding and friendship between countries now separated by language and ideological differences will be infinitely simplified.

It is my personal belief that at the time the Four Freedoms were declared, a Fifth Freedom should have been added: freedom of communication — communication between all men. If such an ideal is ever to be accomplished, it seems probable that your efforts will instrument its realization.

(*A news story and report on the 83d Convention — its Sessions and Equipment Exhibit — are planned for the next issue of the* Journal.)

news and reports

Papers for the 84th Convention, October 20-24, Hotel Sheraton-Cadillac, Detroit

Films and Television in Industry and Education is the general theme under which the 14 Topic Chairmen are working. See the May *Journal*, pp. 344–346, for the topics, chairmen and addresses. Since the April *Journal*, Part II, Membership Directory was published, it has been discovered that the Papers Committee Chairman for Germany was an erroneous listing. Also, the listing for Canada was not complete. These follow:

GERMANY: Adolf Kochs, Bavaria-Filmkunst AG., Schliessfach 9, Munich 9

CANADA: Rodger J. Ross, Canadian Broadcasting Corp., 354 Jarvis St., Toronto

Gerald G. Graham, National Film Board, Box 6100, Montreal 3, P.Q.

E. W. Hamilton, Trans Canada Films, 1210 Burrard St., Vancouver 1, B.C.

Ivor B. M. Lomas, 1362 Orillia St., Ottawa 1, Can.

N. J. Pappas, N. J. Pappas & Assoc., 1778 Beaudet St., St. Laurent, P.Q.

Jack Simonsen, Canadian Broadcasting Corp., Box 175, Halifax, N.S.

Deadlines for Detroit Convention papers are: Abstracts must reach the Program Chairman on or before August 4, and a reading copy of the paper must reach him on or before September 22. (A reading copy may consist of oral delivery drafts, or manuscripts subject to later revision. A final manuscript together with illustrations is, of course, preferable.) Abstracts submitted after the deadlines will be considered but cannot be scheduled without special permission of the Program Chairman and Papers Committee Chairman. Acceptance of papers for the meeting does *not* imply acceptance for publication. Manuscripts require review by the Board of Editors before acceptance for publication.

Author Forms are available from any of the Papers Committee Regional Chairmen, from the Topic Chairmen, from Society Headquarters, and from the Program Chairman and his Associate:

C. E. Heppberger, SMPTE Program Chairman, 510 White Oak Dr., Naperville, Ill.

Harold W. Kinzle, Associate Program Chairman, 1345 Argyle St., Chicago 40.

If you have a prospective manuscript, a project report or a film or demonstration that you believe should be submitted to the forum of the Society in session at Detroit, do not hesitate; see that Author Forms are submitted.

Equipment Exhibit

The exhibitors at the highly successful exhibit held during the 83rd Convention in Los Angeles last April discussed with the Society the advisability of having an exhibit at the Detroit Convention and came up with a rousing affirmative. This will be the first time SMPTE has provided the opportunity for equipment manufacturers to exhibit in the Detroit area, and the vast reservoir of potential interest that exists in the north central states, as well as the nearness of the Canadian motion-picture and television centers in Ontario and Quebec, were compelling factors in the decision.

Plans are now under way locally for organizing another useful and successful show built round the theme of the Convention. Details will be out very shortly. In the meantime, those companies that plan to exhibit and that want to be sure of getting space at the Sheraton-Cadillac (some late-comers at Los Angeles lost out) should send word immediately to Society headquarters, to Denis Courtney's attention.

Fourth International High-Speed Photography Congress

This international meeting at Cologne, Germany, September 22–27, will feature recent discoveries, such as the principle of the rotating mirror with optical balance; and the principle of image splitting will be described in detail. The range of times to be discussed varies from about 1/100 sec down to the lower limit of the smallest measurable time interval, which can be said to be about 10^{-11} sec. The same range in conventional time would extend from one second to 30 years.

The Congress will be highlighted by a special tribute to Carl Cranz, pioneer of high-speed photography, who was born in Germany in 1858. A special stand will be dedicated to his work.

Deadline for papers to be included on the program was May 15, with June 15 as the last day for submitting abstracts and September 22 as the deadline for complete texts. Authors are urged to submit manuscripts as early as possible for the convenience of the translators who must prepare the papers for the trilingual (English, French, German) program. Papers should be sent to Deutsche Gesellschaft für Photographie, Cologne, Hahnenstr. 1, Germany.

Registration will begin Sunday, September 21, and the Congress will open officially Monday, September 22, with ceremonies in the large hall of the Gürzenich. From September 23 to 26 papers will be presented and other activities will take place in the Photofachschule. The school, which has an international reputation, is maintained by the Ministry of Culture of the State North-Rhine-Westphalia with the active support of the city of Cologne and the German photographic industry. All branches of the art and science of photography are taught.

On September 27, a special High-Speed Exhibition will be presented at the Photokina which opens on that date. The Congress is sponsored by the Photographic Society of Germany (Deutsche Gesellschaft für Photographie e. V.).

Requests for additional information should be addressed to Dr. H. Schardin, 10 Rosenstrasse, Weil am Rhein, Germany. Copies of a 36-page brochure have been handsomely prepared with illustrations in color and text in German, French and English. Copies are available from Society headquarters.

The Fifth International High-Speed Congress, scheduled for the Fall of 1960, will be held during the SMPTE Convention at Washington, D.C. The First International High-Speed Symposium was also held at Washington, D.C., concurrently with the 72nd SMPTE Convention.

The Photographic Manufacturers and Distributors Assn., in cooperation with Photo Administrators Inc., New York, is sponsoring a round-trip flight on a chartered TWA Super Constellation for members of the industry who wish to visit Photokina 1958 at Cologne, West Germany. Cost per person is $350 for the round trip, which represents a considerable saving over regular fares. Departure from New York will be on September 24 to Frankfort, Germany. Return flight will start from Paris or alternate departure point on October 17. Additional information is available from Wilfred Knighton, Secy., PMDA, 350 Lexington Ave., New York; or Paul Cherney, Chairman, PMDA Export-Import Committee, c/o Cinefot International Corp., 303 W. 42 St., New York 36.

Education, Industry News

Telemovies, introduced in Bartlesville, Okla., September 3, 1957, (*Journal*, pp. 635–638, Oct. 1957) suspended operations June 6. In making the announcement, Henry S. Griffing, President of Video Independent Theaters Inc., said that the project had not been abandoned but only temporarily suspended. The decision was made "reluctantly," he said, at a time when the "subscriber list is building up steadily." Unfortunately, the rate of gain measured against continuing financial losses was not enough to justify continuing the venture without the use of a metering system, he explained.

The Bartlesville project, which was frankly an experiment, clarified several misconceptions, Griffing indicated. Possible changes which will be made if and when Telemovies resumes operation include the use of a meter system rather than "packaged pictures;" more economical operation with possible use of 16mm film, and diversified programs.

Meanwhile, three experimental pay-TV operations are planned for next year by International Telemeter Corp. The company, which is owned by Paramount Pictures Corp., has developed a "coin-box" meter device for home TV sets.

A recent educational TV survey conducted by the Subcommittee on Television and Teacher Education of the American Assn. of Colleges for Teacher Education showed that of 361 institutions, 252 did not use and had no plans to use closed-circuit TV; 22 were studying its possible use; 50 planned to use it; and 37 are currently using closed-circuit installations. Colleges and Universities using educational TV are located in the following States (where more than one installation, as noted): Alabama, California (2), Florida (2), Illinois (4), Indiana, Iowa, Kansas (3), Louisiana, Massachusetts, Michigan (2), Minnesota, Missouri, Nebraska, New Jersey, New Mexico, New York (5), North Carolina, Ohio (4), Oregon, Pennsylvania, South Dakota and Utah.

The Motion-Picture Industry Credit Group of the National Assn. of Credit Men elected the following officers for the year beginning May 1, 1958: Chairman, Joseph A. Tanney, S.O.S. Cinema Supply Corp.; Vice-Chairman, Kern Moyse, Peerless Film Processing Corp; Committeemen: Jack Fellers, Du Art Film Labs Inc.; Walter Lynch, Mecca Film Labs Inc.; and Everett Miller, RCA Film Recording Studios. The Group, chartered April 1, 1953, with 18 members, now has 29 members in New York, Washington, D.C., and Chicago areas.

A Conference on Televised Instruction will be held August 25 to September 5 at Purdue University, Lafayette, Ind., under the auspices of the National Association of Educational Broadcasters. Among the subjects to be discussed at the Conference are: Policy, Administration, Personnel, Curriculum and Methods, and Inter-Intra Institutional Relations. Conference fee is $100.00. Detailed information is availabel from James S. Miles, Director, WBAA Radio-TV Unit, Purdue Univ., Lafayette, Ind.

The Society for the History of Technology has recently been formed for the purpose of evaluating the impact of technology on contemporary culture. Publication of a quarterly journal, *Technology and Culture*, is planned, beginning in the Fall of 1959. Applications for charter membership should be made to Prof. Melvin Kranzberg, Room 315, Main Bldg., Case Institute of Technology, Cleveland 6. Prof. Kranzberg is Chairman of the organization's Executive Committee. Membership fee is $10.00.

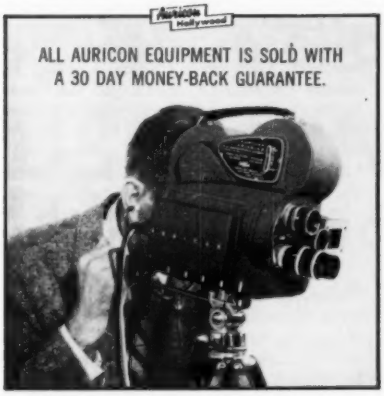
English translations of Russian scientific and technical journals are available through the American Institute of Physics, 355 E. 45 St., New York 17. The AIP has previously offered a translation service, but with the vital importance of exchange of scientific information between the United States and the Soviet Union becoming increasingly obvious, the AIP has launched an all-out campaign to make the published works of Russian scientists generally available. In announcing the service, AIP officials noted that "translations of Soviet scientific journals have been so few and far between in this country that tracking them down has become a formidable task. . . .American physicists have had to learn of Soviet scientific breakthroughs by hearsay and word of mouth, America's major scientific publications have for years been at the fingertips of the Russian physicist."

Four major U.S.S.R. scientific journals are currently offered in English: *Journal of Technical Physics*, 3000 pp., monthly, $90.00 per year; *Journal of Acoustics*, 400 pp., quarterly, $12.00 per year; *Doklady*, Physics Section of the Proceedings of the Academy of Sciences of the U.S.S.R., 800 pp., bimonthly, $25.00 per year; *Journal of Experimental and Theoretical Physics*, 3700 pp., monthly, $75.00 per year. All four publications are available at a group rate of $150.00.

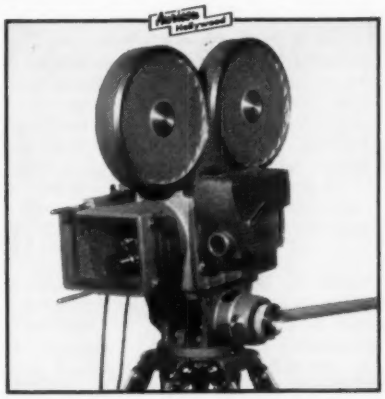
The National Audio-Visual Assn. will hold its annual Convention and Exhibit July 26–29 in the Morrison Hotel, Chicago. Other organizations meeting concurrently include Educational Film Library Assn.; A-V Workshop for Industrial Training Directors; Joint A-V Church Worship Service; Agricultural A-V Workshop; Religious A-V Workshop; A-V Conference of Medical and Allied Sciences; Industrial Audio-Visual Assn.

Prior to the Convention, the tenth annual National Institute for Audio-Visual Selling will be held at Indiana University, Bloomington, Ind., July 20–24. Courses are offered in Salesmanship, Applied Selling, Sales and Business Management

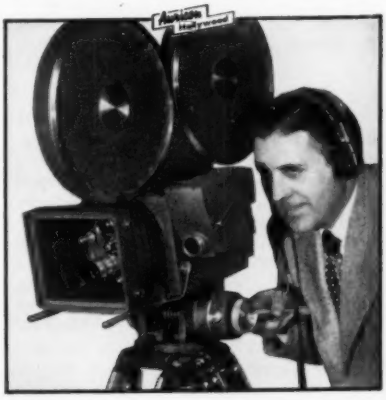
AURICON 16mm Sound-On-Film for Professional Results!



"CINE-VOICE II" 16 mm Optical Sound-On-Film Camera. ★ 100 ft. film capacity for 2¾ minutes of recording; 6-Volt DC Convertor or 115-Volt AC operation. ☆ $795.00 (and up).



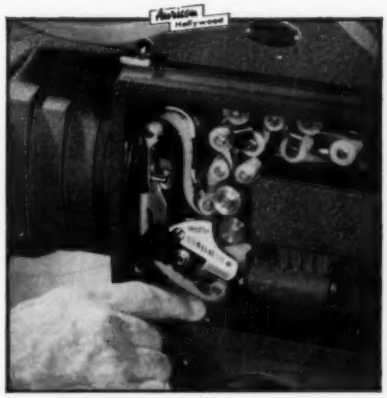
"AURICON PRO-600" 16mm Optical Sound-On-Film Camera. ★ 600 ft. film capacity for 16½ minutes of recording. ☆ $1871.00 (and up) with 30 day money-back guarantee.



"SUPER 1200" 16 mm Optical Sound-On-Film Camera. ★ 1200 ft. film capacity for 33 minutes of recording. ☆ $5667.00 (and up) complete for "High-Fidelity" Talking Pictures.

SOUND RECORDER—Model RM-30... 1200 foot film capacity, synchronous motor for "double-system" 16mm Optical Sound-On-Film operation. ☆ $3630.55 (and up)

PORTABLE POWER SUPPLY UNIT—Model PS-21... Silent in operation, furnishes 115-Volt AC power to drive "Single System" or "Double System" Auricon Equipment from 12 Volt Storage Battery, for remote "location" filming. ☆ $269.50



FILMAGNETIC—Finger points to Magnetic pre-stripe on unexposed film for recording lip-synchronized magnetic sound with your picture. Can be used with all Auricon Cameras. ★ $870.00 (and up)

TRIPOD—Models FT-10 and FT-10S12... Pan-Tilt Head Professional Tripod for velvet-smooth action. Perfectly counter-balanced to prevent Camera "dumping." ★ $406.25 (and up).

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and Preparation and Use of A-V Materials. The Institute is a joint project of the University and NAVA.

Detailed information, such as costs and arrangements for the Institute to be held at Indiana University, are available from the National Audio-Visual Assn., Fairfax, Va.

50 Years Machining for Motion Pictures is the record of **LaVezzi Machine Works,** 4635 W. Lake St., Chicago 44, is celebrating its 50th anniversary. Established in 1908, the company was set up primarily for the manufacture of parts used in the nickelodeons of that time. Its main interest has continued to be the production of machinery for motion pictures, including replacement parts for theater equipment and items made to customers' specifications.

Early contracts of LaVezzi's included making automatic propelled lead pencils, which were new at the time, and a device for automatically cleaning the gap of spark plugs in gasoline engines simply by pressing a plunger on the dashboard; however attention to unique methods of production and to quality of workmanship soon put the firm on its way to specializing in precision projector parts.

A display room including a reference library has been built by Mole-Richardson Co., 937 North Sycamore Ave., Hollywood 38. The reference library covers all subjects pertaining to motion pictures, television and still photography. One section of the library contains equipment information with technical data supplied by various manufacturers. The library is open to the public.

John Mercer, Assistant Professor and Film Supervisor in the Television, Radio and Film Div., University of Iowa, has been appointed Chairman of the Dept. of Printing and Photography, Southern Illinois University, Carbondale, Ill. One of his projects in his new post will be the organization of a motion-picture production unit.

Lewis L. Mellor has been appointed Optical Consultant and Sales Representative to the West Coast for Wollensak Optical Co., Rochester, N. Y. Dr. Mellor is nationally known as an optical lens designer and has designed lenses for a number of leading optical companies.

John Oxberry, President of Animation Equipment Corp., 38 Hudson St., New Rochelle, N.Y., is visiting studios in London, England, and Johannesburg, South Africa, which make animated films. His trip is part of a travel program to exchange information on animation techniques with officials of studios in foreign countries. Data gathered during the tour will be applied to the design of new cameras and equipment for foreign markets.

Walter Clark of Kodak Research Laboratories has been named Chairman of the Honors Committee for the Society of Photographic Scientists and Engineers. Committee members are John A. Maurer and Lloyd Varden of the SPSE New York Chapter, and Roy L. Wolford of the Southern California Chapter. Acting as consultants with Dr. Clark and the Committee in planning the organization's long-range honors program are H. E. Duerr, Binghamton, N.Y.; E. K. Kaprelian, Fort Monmouth, N.J.; Henry Lester, New York; and the chapter presidents.

An Annual Conference is scheduled for October 6–10 in Rochester, N.Y.

Victor M. Salter, Trade and Industrial Sales Supervisor for the New York District of E. I. du Pont de Nemours Co., Wilmington, Del., has been appointed Sales Service Supervisor for Motion Picture Products with headquarters at the firm's film plant at Parlin, N.J. He succeeds Fenner G. Headley who was appointed Manager of the Dallas District. Mr. Salter has been with the firm since 1947.

Harold W. Lindsay, Manager of Industrial Design, Ampex Corp., has been made a Fellow of the Audio Engineering Society. The honor was bestowed because of his pioneering contributions to the design and development of professional magnetic tape recorders in the United States.

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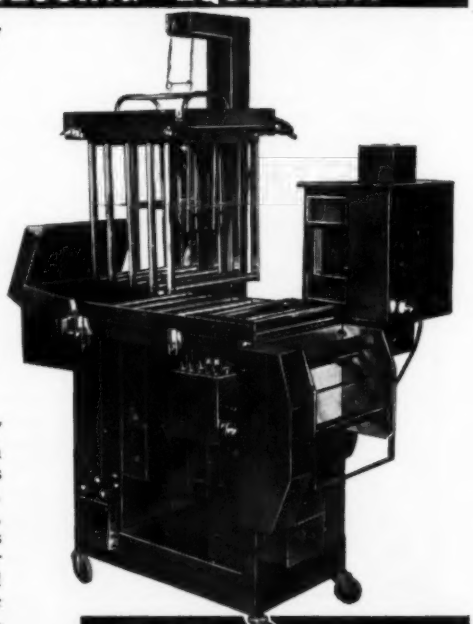
This Fisher Motion Picture Processing Equipment is recognized as the finest in existence. Both units are manufactured to abnormally rigid specifications. Heavy gauge type 316 stainless steel is used throughout. Permanent rust prevention is attained with heliarc welding of all seams. Electrical connections are splash-proofed. Both units are self-threading, operate in daylight, are completely assembled at the factory. Processing times are variable, offering an exceptionally high degree of control of contrast. Temperatures of solutions are also variable and are thermostatically controlled.



Models G-6 and G-12

Model G-6 (110v, 60 cycle) processes film up to 6″ in width. Model G-12 (220v, 60 cycle) processes film up to 12″ in width. G-6 weighs 155 pounds, embodies 14 cubic feet, stands 43″ long, 13″ wide, 66″ high. G-12 weighs 315 pounds, embodies 20 cubic feet, stands 43″ long, 19½″ wide, 66″ high. Both units possess positive drive (variable from 3 to 12 feet per minute). The units are designed, engineered and tested to remove human error. The units incorporate the latest developments available on the spray processing of motion picture film. They also incorporate advances made by the Manufacturer, and not available elsewhere.

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Benzyl Alcohol	PH4.181–1954
Borax, Photo Granular	PH4.230–1954
Boric Acid, Photo Granular	Z38.8.103–1949
Citric Acid, U. S. P. Granular	Z38.8.102–1949
Formaldehyde, N. F. Solution 37%	Z38.8.152–1949
Graphol (Metol)	PH4.125–1956
Hydroquinone	PH4.126–1955
Potassium Alum, U. S. P. Granular	Z38.8.150–1949
Potassium Bichromate, Photo Granular	PH4.300–1958
Potassium Bromide, U. S. P. Granular	PH4.200–1955
Potassium Ferricyanide, Fine Granular	PH4.302–1958
Potassium Metabisulfite, Granular	PH4.277–1957
Potassium Persulfate	Z38.8.181–1949
Sodium Acetate, Anhydrous Granular	PH4.176–1958
Sodium Bisulfite, Photo Powdered	Z38.8.276–1949
Sodium Bromide, U. S. P. Granular	PH4.207–1954
Sodium Carbonate, Monohydrate	PH4.227–1954
Sodium Hydroxide, N. F. Pellets	PH4.225–1956
Sodium Metaborate, Octahydrate	PH4.231–1954
Sodium Sulfate, Anhydrous	Z38.8.175–1949
Sodium Sulfite, Anhydrous Photo	PH4.275–1952
Sodium Thiocyanate, N. F. Crystals	PH4.177–1956
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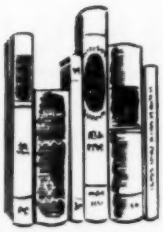

books reviewed

Television Production

The TV Handbook & Dictionary

By Harry Wayne McMahan. Published (1957) Hastings House, 41 East 50 St., N.Y. 231 pp. Illus. 6 by 9-in. Price $7.50.

Harry McMahan's latest book, *Television Production*, should have been entitled "The Television Vocabulary." It is a simple, yet very useful approach to the subject. The whole book is like a very thorough and extensive glossary (the index contains over 2,000 listings) in which the terms are not organized alphabetically — the index provides this function — but are grouped together under the subjects where they apply.

A familiarity with the vocabulary of a new field is the first need of a student of the subject, as well as of the professional who faces his first assignments in the medium. This book can provide a very useful reference during these early stages. It is not intended to be the kind of book that is read through chapter by chapter, although the writing is smooth enough to make this a not unpleasant task.

Although *TV Production* may be of limited value to those who are already at least familiar with the lingo of the medium, it is a book which could well be given to admen, sponsors and public relations people whose frequently encountered ignorance of common terms and processes is time-consuming and irritating to the TV professional. The high price of the volume will unfortunately prevent its use in schools where it might otherwise find adoption in beginning TV production courses.—*Rudy Bretz*, TV and Radio Div., Theatre Arts Dept., Univ. Calif. L.A., Los Angeles 24.

The Measurement of Colour

By W. D. Wright. Published (1958) by the Macmillan Co., 60 Fifth Ave., New York 11. 263 pp., illus., tables. 8 plates (color and black-and white). 8½ by 5½-in. Price $10.75.

A further contribution to color measurement by W. D. Wright is always welcome. His own data on color mixture perceptions formed a significant part of the "standard observer" specifications set in 1931 by the International Commission on Illumination (CIE), and his presentation of such material has always been absorbing.

The present book is a second edition. There has been a considerable questioning in recent years on the detailed exactness of fit of the 1931 standards with actual human vision. The author states that at

one time he "hoped that the CIE would reach a decision about the possible revision of the standard observer data in time for its inclusion in this new edition, but this has not proved to be the case." Thus the book is confined to a considerable reworking of the earlier edition, together with some discussion of the points now at issue (mostly a questioning of the data in the extreme blues, a questioning of the effects of higher brightness and larger field of view, and more fundamentally a questioning of the exactness of linearity of color mixture phenomena).

The general contents of the book cover much more background material on radiation, on the structure and functioning of the eye, and on general photometry. On strictly color measurement it covers the principles of colorimetry, the CIE system, color atlases, and practical colorimeters and spectrophotometers. Applications of colorimetry to three-color reproduction and to general color problems are also covered. Finally a group of useful colorimetry tables is provided in appendixes.

Much earlier presentation of color-mixing phenomena has been very glib regarding the units in which the components were measured. This held particularly in transformed mixture equations, where the components chosen were often non-physical. Dr. Wright has gone to great pains to make these units clear. Another feature contributing to clarity of exposition has been to confine nearly all of the extensive triple groups of linear equations, which adorn all serious discussions on colorimetry, to a single section on "the algebra and geometry of colorimetry." A minor misprint occurs in Plate 4, where the most saturated color swatch is set on the absorption characteristic denoting least saturation.

One is somewhat disappointed that so little is included of the newer techniques for the significant description and specification of color differences. Much of this is scattered, and a good summary would have been most useful here.—*Pierre Mertz*, Lido, Long Beach, L.I., N.Y.

A new List and Index of American Standards has been announced by ASA. The 67-page Index contains 465 standards published since the 1956 edition. A total of 1720 American Standards are listed; 43 recommendations of the International Electrotechnical Commission and 44 of the International Organization for Standardization. A total of 275 standards (pp. 47–52) relate to photography and motion pictures. Further information is available from American Standards Association, 70 E. 45 St., New York 17.

The 8mm Cine Guide by Robert Grosjean and Pierre Monier is a publication of Paillard Ltd., Sainte-Croix, Switz., available from Bolex franchised dealers. Written especially for amateurs and hobbyists, the 100-page booklet is beautifully illustrated and contains many helpful suggestions. It is priced at $1.50.

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section reports

The Canadian Section made the National Film Board Auditorium in Montreal its headquarters for its January 21 meeting. The members and guests present numbered 48, who listened to Norman Oldring, Montreal Program Sub-Chairman, outline future program plans and introduce the two speakers for the meeting.

The first speaker was Colin Low of the animation department of the National Film Board who delivered a talk on "Animation in Canada." Mr. Low discussed the various types of animation and illustrated his talk by showing examples of the various types of animation films produced by the National Film Board. Hano Champagne of the Vickers & Benson Advertising Agency followed with an outline of the function of the advertising agency.—*R. E. Ringler*, Secretary-Treasurer, c/o Du Pont Co. of Canada, Ltd., 80 Richmond St., W., Toronto.

The Canadian Section held its February 20 meeting at Shelly Films Limited, Brockhouse Rd., Toronto. An audience of 75 was on hand to hear Rodger Ross of the Canadian Broadcasting Corp. open the meeting by outlining the steps that had been taken up to that time by the Laboratory Standards Subcommittee in Canada. He related that the National Research Council and the National Film Board were agreed to supply the criteria on which all sensitometric data would be based. Ken Carey of the National Film Board outlined the comparative accuracy of all labs participating in the Canadian laboratory standardization program. Mr. Ross then introduced Gordon Chambers of the Eastman Kodak Co., Rochester, N.Y., who discussed sensitometric and chemical methods that are available to laboratories and their adaptability to individual operations. He also discussed the problem of obtaining comparative speed index values on negative films in different laboratories. To round out the program, R. G. Neuhauser of Radio Corp. of America gave an excellent paper in which he discussed the development of the vidicon tube as well as its applications in the industrial and closed-circuit fields.—*R. E. Ringler*, Secretary-Treasurer, c/o Du Pont Co. of Canada Ltd., Toronto.

The Chicago Section had more than 65 members and guests present for its first meeting of 1958, held at the Prudential Building in Chicago on January 24. The program was conducted by H. H. Brauer, newly elected Chairman of the Section, and began with a screening of a color motion-picture short *Ideas and Film*, produced by Telecine Film Studios. The paper featured that evening, was "Economic Considerations of Closed-Circuit TV System Design." Donald Kirk of Jerrold Electronics, Philadelphia. (The full, formal version of this paper appeared in the *Journal*, pp. 661–671, Nov. 1957.) The lively question-and-answer period which followed centered around the practical aspects of the company's first full-scale installation in Bartlesville, Okla. Informal discussion continued throughout the coffee break at the conclusion of the scheduled evening's activities.—*William H. Smith*, Secretary-Treasurer, 801 S. Third St., Chesteron, Ind.

The Chicago Section had a turnout of approximately 160 on February 24, for one of the "on location" meetings that have proved so popular with the members of that section. The meeting was held on the sound stage of Kling Film Productions in Chicago.

Opening the meeting was a screening of a 35mm color short, *Swing 'n Sell*, produced by Kling, and a welcome by Dick Hertell, Production Manager of Kling and new Chicago Section Program Chairman. The central topic of the evening was expressed in a paper by Charles J. Hirsch of the Hazeltine Research Corp., entitled "An Instantaneous Electronic Color-Film Analyzer". Mr. Hirsch included slides in his presentation to explain in detail the principles and circuitry of the equipment which is designed to make possible rapid and accurate timing of color motion pictures. Leonard Giarraputo of Pathe Laboratories, New York, described the experience of that organization in the use of the equipment, emphasizing its practical operational as-

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R.M.S. Meters F.S.D. • 1.0% R.M.S.
R.M.S. Meters F.S.D. on divide by 5 range • 0.2% R.M.S.
Cross over frequency • 20 c.p.s. plus/minus 5%
Flutter meter response • —3dB at cross over —2dB at 200 c.p.s. • —8dB at 3000 c.p.s.
Wow meter response • —3dB at cross over —1dB at 0.5 c.p.s.
C.R.O. Output frequency response • Level down to zero frequency • —2dB at 200 c.p.s.
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C.R.O. Output Maximum signal • 140 volts Peak to Peak
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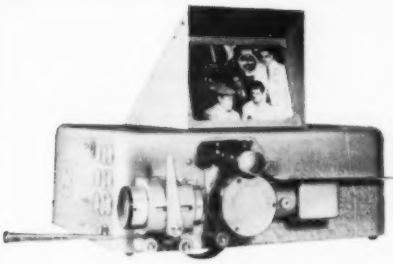

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Easy threading, portable, will not scratch film. Views film left to right on 6"x4½" brilliantly illuminated screen. Sound Reader and/or Counter easily attached. Available in 16mm.

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When "location" is just a cab-ride away, it's comforting to know that CECO'S vast storehouse of sales and rental equipment is at your disposal. But when you have to journey to the North Pole or to the South American jungle, it's even more important to depend on CECO for cameras, dollies, lights, generators and a host of other equipment that will perform under severe climatic conditions.

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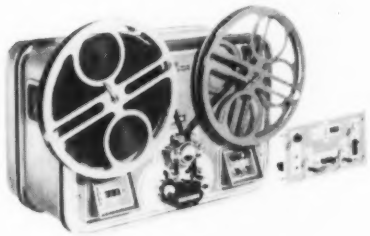

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3-Wheel Collapsible Lightweight Dolly

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3-WHEEL DOLLY collapses into compact shape. JUNIOR weighs 15½ lbs. SENIOR weighs 18 lbs. Any tripod easily attached. Ball bearing locking rubber tired casters with indexing device.

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pects and time saving features, using screened examples to clearly illustrate his findings. (The paper, as presented at the Society's Philadelphia Convention, was published in the *Journal*, pp. 17–26, Jan. 1958.)

Following a question and answer period, the meeting adjourned to a coffee and donut break provided by the host company. Subsequently, members of the Kling Film Productions staff conducted informal tours of the facilities for all interested members.—*William H. Smith*, Secretary-Treasurer, 801 S. Third St., Chesterton, Ind.

The Dallas-Ft. Worth Section's March 14 meeting was particularly well attended (60) since it was a joint meeting with the IRE. The program was opened by exerpts from the best newsreel films of 1957, which were of particular interest because three of the films shown were made by Gordon Yoder, a member of the Section. As a result of Gordon's work, he was named "Newsreel Cameraman of the Year." William Metzger, Eastern Mgr., Professional Motion Picture Dept. Ansco, presented a paper on "A New High Speed 16mm Reversal Color Film Super Anscochrome," which was of prime interest to the people from film production companies in the area. Frank G. Viscardi, Vice-President of the Electron Corp., presented an informal talk and demonstration of the closed-circuit TV cameras being manufactured by his company. A great deal of interest was shown by the audience since the camera appeared to be very compact, well designed and inexpensive. A rather active discussion period followed his presentation. Coffee and donuts, supplied by the IRE, were enjoyed by all at the meeting.—*E. J. Pattist*, Secretary-Treasurer, 3618 Marsh Lane Pl., Dallas, Texas.

The Hollywood Section members and their guests, approximately 225 strong, crowded into the Preview Studio Theatre on January 21 to hear William J. Wagner, KRON-TV; William Adams, Rocketdyne Div. of North American Aviation; and Harold Scheib, Cinema Research Corp.

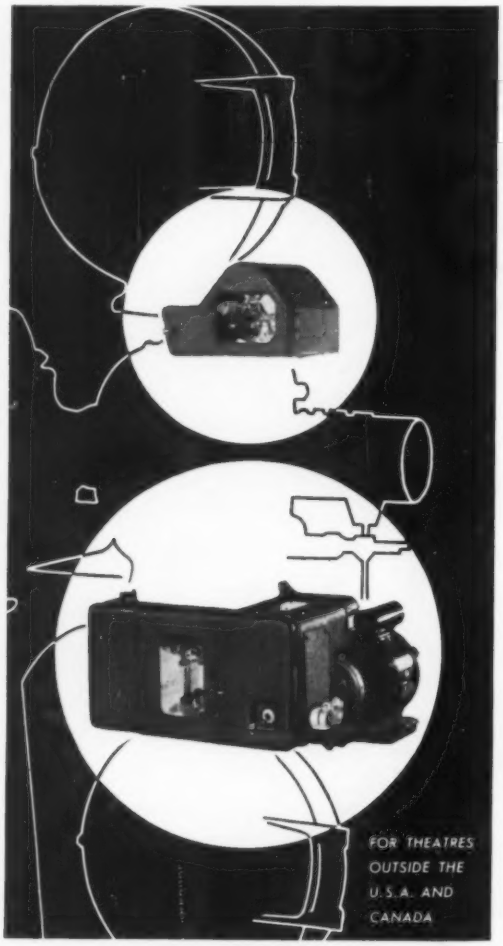
Mr. Wagner described the color palette that he developed at Station KRON-TV and calls the ChromaCHron, which catalogues a number of paints used in scenic artwork in terms of their black-and-white and color reproduction through a color TV system. A film showing the use of this system was projected. (Mr. Wagner also presented this paper at the Society's Convention at Philadelphia and it appears on p. 369 of this *Journal*.)

A Road to the Stars, a documentary film covering the history of rockets, was shown by Mr. Adams, who also produced and directed it. A discussion of the production problems followed.

Mr. Scheib followed this talk by discussing the problems concerned with making the color intermediates required for making the 16mm color release of the film from the 35mm color negative on which the original production was filmed.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Hollywood Section meeting of February 18 was devoted primarily to entertainment and attracted a near-record attendance of 640 members and guests to the Walt Disney Studio Theatre for the showing of two color films. The first film, *The Thunderbirds*, was produced by the United States Air Force. It shows the precision flying of four specially selected pilots, members of an exhibition group who have done aerial acrobatics representing the United States at military air shows both at home and abroad. The concluding film of the evening was *Mars and Beyond*, produced for the Walt Disney Studio by Ward Kimball. This motion picture is the third in a series on space travel and is handled in a manner both humorous and scientific. Following the film, Mr. Kimball gave a short talk on the making of science films and the problem of keeping them both entertaining and factual.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Hollywood Section had SMPTE Past-President John G. Frayne of the Westrex Corp. as its speaker for the March 18 meeting, held at Paramount Pictures Corp. in Hollywood. Approximately 260 members and guests were on hand as Dr. Frayne explained the workings of the Westrex Stereophonic Disk Recorder, involving the use of a 45-45 system of obtaining two stereophonic recordings in a single groove with a single stylus. Slides were presented as well as a demonstration of the system, to point out the principles



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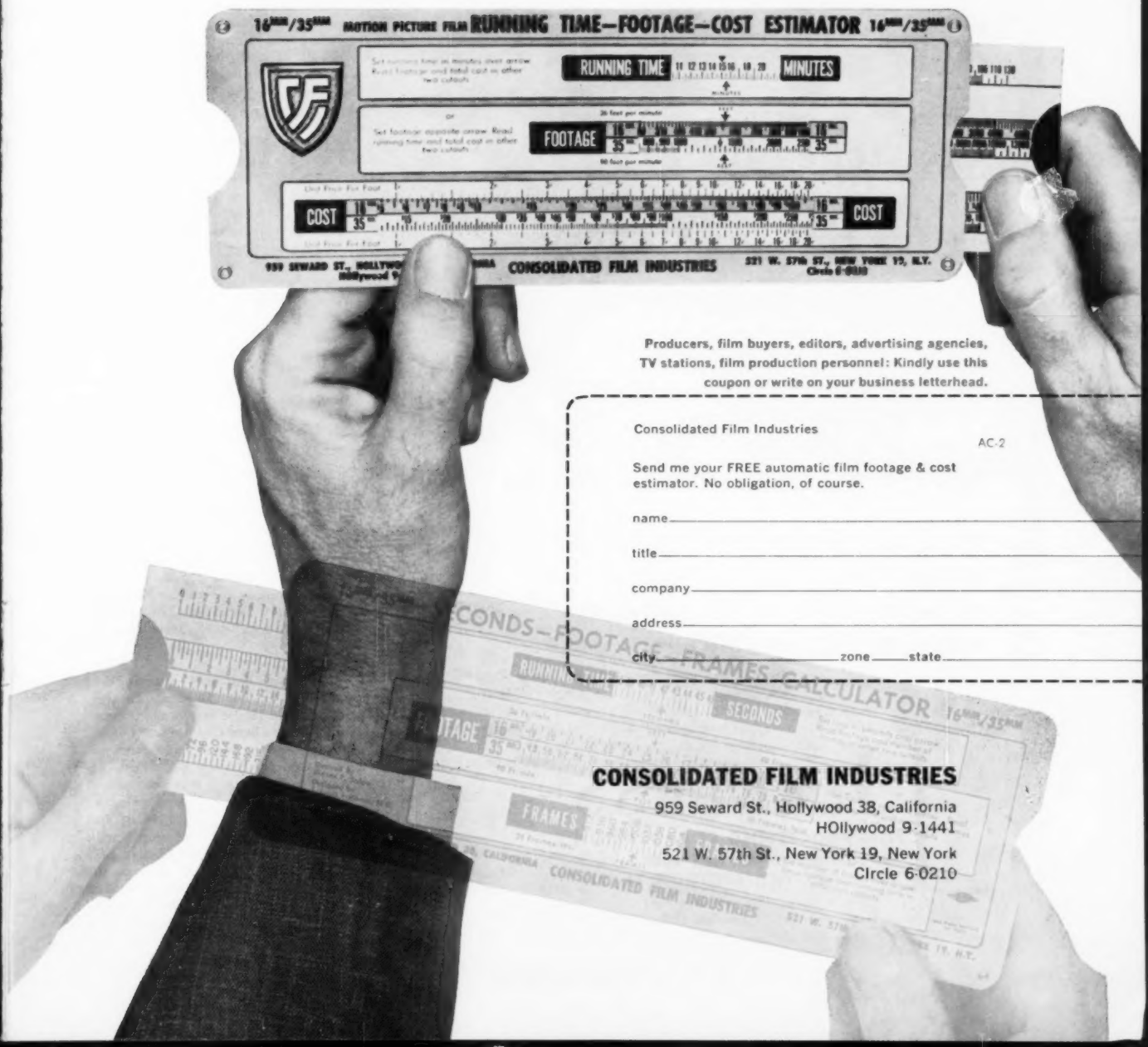

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involved in this method of stereophonic disk recording. It was established that this system is being adopted by the recording industries in the United States and Europe as a standard for stereophonic disks.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The New York Section had a better-than-average turnout for its January 22 meeting at the Carl Fischer Concert Hall on West 57th St. Approximately 140 members and guests heard John Whittaker, Photographic Engineer, CBS Television, give his paper "Monochrome Film Standards for Television" (January 1958 *Journal*). The animated discussion that followed evidenced a great deal of interest in the subject.

Two innovations tried at this meeting appeared to meet with the approval of the assemblage. They were an earlier starting time, 7:30 rather than 8:30 p.m. and a coffee break between the delivering of the paper and the discussion, which promoted a very social half-hour.—*Robert M. Fraser*, Secretary-Treasurer, c/o National Broadcasting Co., Rm. 578, New York 20.

The New York Section had an unusual "double-feature" meeting on February 11 and 13. The regular technical meeting was held on the 11th at the Carl Fischer Concert Hall on West 57th St., while the added attraction of a tour of the new color facilities at Movielab Film Laboratories was held two days later.

Approximately 85 members and guests attended the former session and heard three speakers on the general subject of "New Methods for Film Maintenance." Boyce Nemec, newly appointed Vice-President of Reevesound Co., spoke on the economics of film maintenance, comparing the cost per showing of a 16mm film, 35mm and video tape, and the effect that good film maintenance practices might have on these costs. Next, Richard Sassenberg of Piclear, Inc., demonstrated a device for removing the effect of film scratches during projection. To complete the evening's formal program, an ultrasonic film cleaner was described by Robert P. Gutterman of General Kinetics, Inc. His talk was accompanied by a 16mm film showing the cleansing action of the ultrasonic forces in a striking manner. Following the speakers there was a general discussion of television film handling. The very absorbing session was completed with a social period during which coffee, "cokes," and doughnuts were served through the courtesy of the Motion Picture Div. of the Eastman Kodak Co.

Two days later, 150 members of the New York Section were the guests of Movielab Color Corp. at an open house. Following the tour of the new Movielab color facilities at 619 West 54 St., conducted by Saul Jeffee, President of the organization and his assistants, refreshments were served. —*Robert M. Fraser*, Secretary-Treasurer, National Broadcasting Co., Rm. 578, 30 Rockefeller Pl., New York 20.

The New York Section entertained a gathering of 75 members and guests at its March 11 meeting held at the Carl Fischer Concert Hall in New York. The speaker for the evening was Philip C. Erhorn of Audiofax Associates, whose subject was "Microphones — Types and Uses." Various types of microphones were compared as to characteristics and suitability for divers applications. Mr. Erhorn drew on his experiences as an audio engineer for radio and television broadcasting and as a consultant in audio matters to give a well rounded talk on microphone techniques.

Following the talk, a "coffee and cake" break with refreshments provided by the Photo Products Div. of E. I. du Pont de Nemours and Co. was enjoyed by the group. After this social half-hour, those members who did not have to catch trains returned to their seats for an informal discussion of the talk with the speaker. A pre-meeting dinner at Al and Dick's Restaurant was attended by the Board of Managers and the speaker, on a "dutch treat basis." It is planned to make this a regular occasion before each monthly meeting.—*Robert M. Fraser*, Secretary-Treasurer, c/o NBC, Rm. 578, 30 Rockefeller Pl., New York 20.

The Rochester Section's meeting of February 27 at the Dryden Theatre, George Eastman House attracted 40 members and guests to hear Charles L. Rouault, Consulting Engineer for Defense Electronics Div. of General Electric Co. review his recent trip to Russia as a representative of the IRE. He described the technological status of the industrial plants visited and gave his impressions of the people with whom he came into contact. Active participation of the audience during the discussion resulted in a general feeling among the group that their knowledge of Russia had been broadened. The program was opened by the film *Road to the Stars*

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Scratches are havens for dirt, and refract light improperly. On the screen, they mar the picture and may distract attention. If on the sound track, they produce offensive crackling.

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Mr. Lansburgh is famous for his productions made under extreme, rugged conditions... in jungles, deserts, mountains... and relies on the famous Magnasync equipment for perfection in recording. Scoring and re-recording for "Wetback Hound" was performed by Glen Glenn Sound Company— also users of Magnasync equipment.

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JAPAN: J. Osawa & Co., Ltd., 5 Ginza Nishi 2-Chome, Chuo-Ku, Tokyo, Japan; Tel: Tokyo 56-8351-5; Cable "OSAWACO."

produced by North American Aviation, reviewing the history of rocketry.—*R. E. Putnam*, Secretary-Treasurer, 420 E. Corey Rd., Syracuse, N.Y.

The San Francisco Section met on February 18 at W. A. Palmer Films, Inc., to hear Bill Palmer discuss the latest techniques in optical and magnetic sound for 16mm films.

The inherent faults of variable-area and variable-density optical recording and the methods used to minimize them were described with particular emphasis on the requirements for obtaining good sound. Typical problems met with in electrical printing from magnetic originals were covered, including a description of the methods used to compensate for emulsion characteristics. Examples of various types of 16mm sound were shown, demonstrating the characteristic distortions resulting from typical printing errors. A short film was also run to show the quality of magnetic stripe sound obtained in the course of normal operations of the News Department of KRON-TV.

Before the meeting, the members met for dinner at Henry's Fashion Restaurant. After the meeting the sound recording facilities of Palmer Films were available for inspection by the members.—*Roger Woodruff*, Secretary-Treasurer, c/o KRON-TV, 929 Mission St., San Francisco.

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The San Francisco Section's meeting on March 18 had as its subject "Special Photographic Effects as Used in Modern Theatrical Films." There were 35 members gathered at the Motion Picture Service Co. in San Francisco to hear a paper by Mr. L. B. Abbott, Chief Engineer, Special Effects Dept., 20th Century-Fox Pictures, which was read by Chairman Werner Ruhl in Mr. Abbott's absence. A special 35mm CinemaScope film was shown illustrating the steps involved in the photographic effects techniques in use at 20th Century-Fox, complete with examples of the finished product. One of the most interesting of these was the traveling matte. (The *Journal* has benefitted from earlier experiences of Mr. Abbott who, with Ray Kellogg, contributed "Some Special Photographic Effects Used in Motion-Picture Production," published in February 1955.) Following the demonstration film, the members were shown in full length, *The Rains of Ranchipur*, which had some very spectacular earthquake and flood scenes produced by a combination of miniatures and live action. Even knowing the techniques used, the overall effect was startling. The meeting was of particular interest to the members, because very little of this type of work is done in the Bay Area.—*Rodger L. Woodruff*, Secretary-Treasurer, c/o KRON-TV, 929 Mission St., San Francisco.

The Washington Section's February meeting which promised to be one of the most important and best attended of the season, suffered a bad setback because of the extremely inclement weather at the Capital on the 18th. Despite the closing of all U.S. Government offices in the area on the day the meeting was held, a hardy few who lived close to the National Academy of Sciences, 2101 Constitution Avenue N.W. were able to attend.

The subject for the meeting was International Television and the agenda included papers by Max G. Kosarin, U.S. Army Pictorial Center, Long Island City, N.Y., on "The Problems and Methods of Language Narration as Applied to Bilingual Film," Leon Shelly, Shelly Films Ltd., Toronto, Can., who spoke on "Future Trends in Multi-Voice Films for International Television," as well as papers by T. H. Bridgewater, British Broadcasting Corp., London, on "Eurovision" and William S. Halstead, President, Unitel, New York, on "The Narcom Plan," which were read by Ellis W. D'Arcy, the speakers being unable to be present because of distance barriers. (These papers appeared in the March 1957 *Journal*.)

The meeting started with the showing of a film, made by the U.S. Information Agency for overseas presentation, which briefly described the U.S. Satellite Program and showed the actual motion pictures of the launching of the first U.S. satellite, the "Explorer." All of the papers were illustrated by slides except Mr. Kosarin's, which was accompanied by a 16mm film. George Lewin also of the U.S. Army Pictorial Center assisted in the demonstration of the film.—*Henry M. Fisher*, Secretary-Treasurer, 4003 Underwood St., Chevy Chase, Md.

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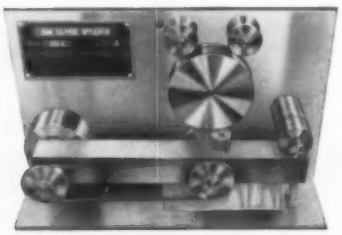

This applicator is film driven and is used in applying a redeveloper agent, hypo, or sulphide to the sound track area of color motion picture release film.

The applicator wheel may be set to either side of the film drum to accommodate either head or tail film travel. The distance between applicator wheel and film is adjustable through a calibrated eccentric having 1/1000 of an inch graduations. A spring return is provided to permit passage of splices.

The unit is of stainless steel construction except for details unobtainable in stainless steel. Less than three ounces of film tension is required to operate the applicator.

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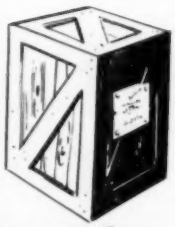
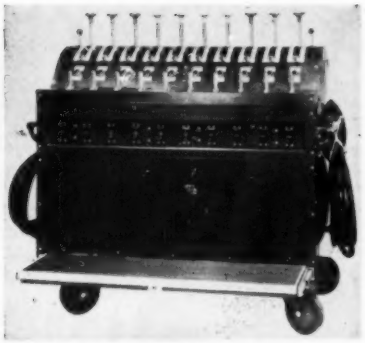


new products

(and developments)

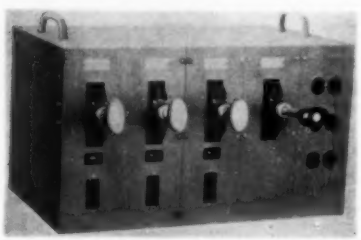
Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

Two new lighting units have been announced by General Electric Co., Ltd., Magnet House, Kingsway, W.C. 2: a 2-kw spotlight weighing 27 lb complete with remote control yoke; and a 5-kw spotlight weighing 60 lb complete. The new spotlights, constructed of sheet steel, are designed to house Osram 2-kw and Osram 5-kw lamps, respectively. A specially designed cooling system allows air to pass through the unit at any angle at which it might be operated. A newly designed bi-post lampholder, with a spherical backing reflector, can be adjusted to hold the lamp at all operational angles. Each unit can be supplied with a yoke which houses a newly designed self-locking system which enables an operator to tilt, pan, focus or switch an otherwise inaccessible unit by using a light aluminum pole. If preferred, the units can be supplied with a conventional yoke which terminates in a spigot made to B.S. 2063: 1953. The lamphouse is locked to the yoke by a single side clamp. When the clamp is released the lamphouse is free to rotate in its yoke. Specially designed accessories, including "barn doors" and "snoots," fit into a small channel section which is an integral part of the front door of each unit. This method of holding accessories makes it possible to keep the lens of a unit unobstructed when a "barn door" is open. In addition to other accessories, a newly designed "barn door," which can be rotated and its doors positioned by means of the remote control operating pole, is available.



A new dimmer combination consisting of two 5000-w, four 2000-w and four 1000-w resistance-type dimmer plates has been announced as Type 367 by Mole-Richardson Co., 937 North Sycamore Ave., Hollywood 38. The Combination interlocks in any combination and features graduated scales, colored operating handles for each wattage, adjustable cue stops and numbered circuits. Weight is 940 lb. Dimensions are: height, 59 in.; width, 27 in.; and length, 62 in.

The company has also announced a Type 1761, 30-kva, 3-phase, 60-cycle Transformer. Designed to convert from 240 or 480 v, 3-phase, to 120 v, the transformer features low noise level. Dimensions are: height, 44 in.; width, 25 in.; length, 43½ in. It weighs 790 lb.



The Controlite dimmer bank, a product of Ward Leonard Electric Co., Mount Vernon, N.Y., is now available in a smaller packaged version called the Controllette. Announced by Ad. Auriema Inc., 85 Broad St., New York 4, the packaged dimmer units are available with a choice of 3, 4, 5 or 6 individual lighting controllers, each of which can be mechanically interlocked with any of the others or can be made to interlock to a master lever, if desired. Designed for 60 cycles, 110 v, the unit is ready to plug in when delivered. Prices range from $625.00 for the 3-unit package, with solid output and without a master handle, to $1095.00 for the 6-unit package with a double-pin plug and with a master handle.

A Pulsed Xenon Arc Lamp (PXA), recently developed by General Electric has been incorporated in a line of lighting equipment produced by American Speedlight Corp., 63-01 Metropolitan Ave., Middle Village 79, L.I., N.Y. A joint announcement was made by the two firms.

The PXA is a tubular quartz lamp designed primarily to expose slow-speed photosensitive materials. It operates with a radar-like pulsing effect, flashing on and

What The Well Dressed Editing Room Should Wear

EDITING TABLE & RACK

FILM RACK

REWIND

EDITING TABLES & RACK:

HFC editing tables are made of strong angle iron construction with a bottom reel rack, formica table top, and 9" x 12" flush light well. Stock tables are 24" W x 60" L x 30½" H (ETBR-1) and 28" W x 60" L x 30½" H (ETBR-28). Any size can be made to the editors specification. The 4 tier table rack fits directly onto the back of the table and is ideal for holding small rolls of film for intercutting. (TR-1).

FILM RACK:

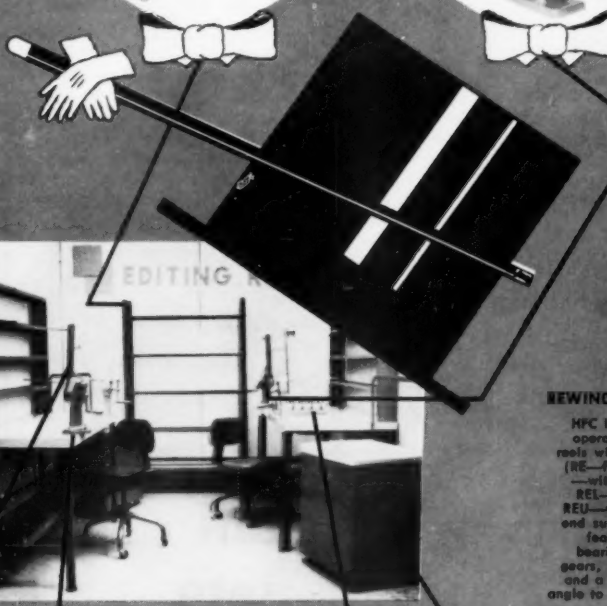
HFC angle iron film racks are inexpensive and especially made for 35mm 1000' reels or cans. Each tier holds up to 25 reels or cans. The entire rack can be taken apart and additional holes drilled to move the rods to positions for other reel sizes. Stock sizes are: 4 tier - AR-4, 5 tier - AR-5, 6 tier - AR-6, 7 tier - AR-7.

SWIVEL BASE:

HFC swivel bases enable the editor to turn the rewind to 2 additional positions for rewinding the film to be taken up from the editing machine or film bin in proper alignment. The rewind is attached onto the swivel base, which is bolted to the table (SB-1).

LEADER STANCHION:

HFC leader stanchions are attached to the HFC rewind and will hold 3 reels of leader or effects on top shaft front and one reel of leader on shaft in back facing the operator (LS-1)



FILM SYNCHRONIZER:

All types of synchronizers of 16 or 35mm are available from stock, as well as 16 & 35mm combinations; and 35 - 32 and 35mm combinations. Units to handle 55mm, 65mm and 70mm are available on special order.

REWINDS:

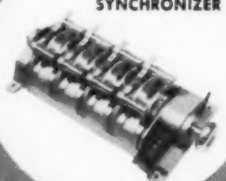
HFC hand rewinds permit the operator to pull one or more reels with a minimum of effort. (RE—for normal winding, REF —with a top friction control, REL—with elbow brake and REU—with universal joint and end support). The outstanding features are: enclosed ball bearings, precision steel cut gears, interchangeable shafts, and a base which is cut at an angle to keep reels from moving up and down the shaft.

FILM BINS:

HFC steel film bins are available with hooks and casters. Trims are held on the hooks prior to matching. Film bin liners made of cotton drill are used on the inside of the bins to keep the film from being scratched or getting dirty. (SFB-1, 18" x 24" x 24"; LFB-1, 22" x 23" x 32")

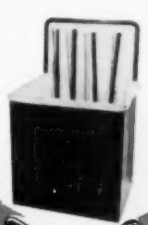
SWIVEL BASE

SYNCHRONIZER



LEADER STANCHION

FILM BIN



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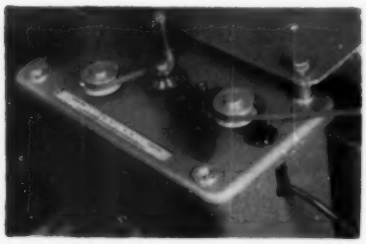
off 120 times a second. Less than a half-inch in diameter, the lamp is available in lengths ranging from 3 to 36 in. It can be used in high-speed photography. The photograph, which shows a falling flashbulb, was made by the light of the new lamp.

The lighting system which incorporates the PXA was developed chiefly for printing and publishing applications. Characteristics which make this lamp especially useful for these applications include a color temperature effective with photosensitive materials, high wattage concentration, and adaptability to reflecting surfaces. It can be turned on and off for each exposure with no warmup time. Under typical operating conditions the life of the lamp averages 50 hours. The lamp receives pulses of current from its ballast system, a pulse for each half-cycle of the line frequency, or 120/sec on a 60-cycle line.



The TN Tempo Regulator (previously called the Acoustical Time Regulator) is a device for increasing or decreasing the playback time of a tape recording without altering pitch, or, within certain limits, without increasing distortion. The basic machine was invented about ten years ago by Anton M. Springer of Telefonbau und Normalzeit GmbH., Frankfurt am Main, Germany. The improved 15-in./sec machine, Model 38, is available in this country from the Tele-Norm Corp., 55 W. 42 St., New York 36; the price is $1990 f.o.b. New York. It was demonstrated at the National Assn. of Broadcasters Convention in April at Los Angeles.

The Tempo Regulator consists, essentially, of a specially designed capstan drive which operates in conjunction with a rotating, four-section playback head in the form of a cylinder with the four gaps equally spaced around its circumference. Automatic means are provided so that when the speed of the tape is changed the cylinder will rotate so as to maintain a constant speed of 15 in./sec relative to that of the tape.

The tape contacts the head for exactly one-fourth of its circumference. Thus, when the tape speed is increased, shortening the playback time, the head rotates in the same direction as the tape, and bits of information are removed during each revolution. When the tape speed is reduced, thus lengthening the playback time, the head rotates in the opposite direction and bits of information are repeated during each revolution. When the tape speed is exactly 15 in./sec, the head is stationary and normal reproduction is obtained.

Since the relative speed between tape and head remains constant, the pitch is unaffected, but, of course, the bits of information removed or repeated must be short enough to be practically unnoticeable. It is claimed that the tape speed can be reduced to 90% or increased to 120% of normal before distortion becomes objectionable.

Camera Equipment Co., 315 W. 43 St., New York 36, has introduced the Pye Transhailer, an extremely lightweight electronic megaphone which features a germanium transistor amplifier. Powered by standard flashlight batteries, it is 15½ in. long with a horn 10½ in. in diameter. Weight, including batteries, is 5 lb. With a reported operating range of a quarter of a mile under normal conditions, it has a maximum power output of 3½ w. Retail price is $99.00.

Two new recording instruments, the Stereo Magnecordette and the P-75 Editor II, have been announced by the Magnecord Div. of Midwestern Instruments Inc., Tulsa, Okla. The Magnecordette is designed for simplicity of operation in recording or playback. It features stacked-in-line stereo, halftrack monaural with tape speeds of 3¾ in. and 7½ in. The reel size is 5 in. and 7 in. Frequency response is 50 – 12 kc ± 2 db at 7½; 40 – 15,000 cps ± 2db at 15 ips; 50 – 6 kc ± 2 db at 3¾. The signal-to-noise ratio is reported to be down more than 58 db from the 3% third harmonic distortion point and the channel-to-channel crosstalk more than 50 db down. It is priced at approximately $395.00 with custom cases and cabinets optional at a nominal additional cost. The P-75 Editor II features fail-safe brakes and tape break automatic shutoff. It has a timing of ± 3 sec in 30 min with a high forward and rewind time reported as less than 100 sec for a 10½-in. reel. The unit weighs 51 lb in the carrying case.

The company also announced the M-90 stereophonic recorder-reproducer featuring pushbutton controls and 15 and 7½ in./sec with switch selection, instantaneous start and stop, high-speed cuing control and remote control. A record interlock has been designed to prevent accidental erasure, and dual record and playback amplifiers permit monitoring from each channel.

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The Trickoma II is a versatile optical printer for making copies from either 35mm or 16mm to either 35mm or 16mm film. Optical magnification can be varied from 1 : 3 to 1 : 0.33, the image being automatically focused at all magnifications. Provision is made for frameline correction, for multiple-frame and skip-frame printing, for making fades and dissolves from 16 to 90 frames in length, for cut-out copying with vertical and horizontal adjustment on area copied, and for operation at either 10 frames/sec or 1 frame/sec. A viewing magnifier is provided at both gates. Operation of the printer is programmed and controlled from a remote control panel. (Abstracted by John G. Streiffert, Eastman Kodak Co., Bldg. 59, Kodak Park, Rochester N. Y., from "Optische Trick-Umkopiermaschine Trickoma II," by P. Zschoche, *Filmtechnikum, 9:* 103, Apr. 1958.)

A lightweight metal cradle which may be used with lenses too long or too heavy to depend on the camera mount for support has been announced by Karl Heitz Inc., 480 Lexington Ave., New York 17. Originally designed by Kinoptik for its series of color-matched 16mm and 35mm Apochromats, (*Journal*, p. 508, Aug. 1957), the cradle is threaded to fit any standard tripod or dolly. It is priced at $99.00.

Development of an electron tube not much larger than a shirt button ($\frac{1}{2}$ in. in diameter and $\frac{1}{4}$ in. thick) has been announced by General Electric Research Laboratory, Schenectady, N.Y. The miniature tube, constructed of layers of titanium and a special ceramic, is capable of operating at temperatures of from 900 to 1500 F. The design is still in the laboratory stage and no tubes are, as yet, commercially available.

A two-terminal passive semiconductor component, developed by Bell Telephone Laboratories, has been announced. Called a field effect varistor, the experimental device has a constant-current feature which would make it suitable for use as a current regulator in circuits where the load or supply voltage might vary over wide limits. Related in principle to the field effect transistor, it contains a single planar junction which is made by diffusion. Current passes parallel to this junction through a constricted region called the channel. As the voltage is increased, the current increases and a depletion layer builds up which eventually reaches through the entire thickness of the channel. At this point a further increase in voltage does not produce any increase in current. At this point the current is essentially constant and remains so until the voltage is increased to a point where an avalanche breakdown occurs. At present the varistors are fabricated by cutting dice from a slice of germanium or silicon containing a single diffused junction. The dice are heavily plated on all surfaces, and a circular trench is cut into the diffused layer to within about 0.1 mil of the junction. Leads are attached by thermo-compression bonding or other convenient means.

Autotronics Inc., Rt. 1, Box 812, Dept. 12, Florissant, Mo., has announced a line of small electromagnetic clutches. Called

AIM Model C-125, the units have 1.125 pilot mounting diameters, clutching torque of 40 oz-in., no slip rings and are self contained. When energized, the output and input shafts are coupled together, and are free running when de-energized. The clutches are applicable to tape recording equipment and other automatic controls.

The Tele-Trol System for reception and redistribution of TV signals has been announced by Jerrold Electronics Corp., 23rd and Chestnut Sts., Philadelphia 3. The system consists of two units, Model TM Transmitter-Modulator and Model TD Receiver-Demodulator. The Receiver-Demodulator is designed to receive and demodulate VHF TV signals. Basic applications are "off-the-air" pickup of TV programming for the broadcaster, closed-circuit and community antenna systems. It features 60 db IF rejection of adjacent carriers, noise suppression circuitry, "keyed" AGC and manual gain control, station-outage squelch circuitry, conversion of any VHF channel, and an optional crystal-controlled lock-in oscillator.

The Transmitter-Modulator is a low-power TV transmitter which provides standard vestigial sideband output on VHF TV channels 2 through 6 from standard video 4.5-mc sound sources. It is designed for distribution of VHF TV signals in microwave applications, closed-circuit and community antenna systems. It features sideband filtering, phase equalization, crystal-controlled output, controllable modulation percentage, internal regulated power supply, and an optional 4.5-mc accessory modulator which permits the unit to be used with a microphone.

A new splicing tape for splicing and editing video-tape recordings, and a new leader with a special write-on coating for labeling a recorded roll of video tape have been announced by Minnesota Mining and Mfg. Co., Dept. A8-127, St. Paul, Minn., as companion items to the firm's Scotch video recording tape No. 179. The splicing tape is an aluminized polyester film material with a special low-cold-flow adhesive. The aluminum coating drains off static charges during splicing to facilitate ease in handling in all temperature and humidity conditions. It has a ½-mil backing and is ¼ in. wide and 66 ft long. The leader and timing tape is 2 in. wide and 150 ft long. It features a special finish which permits labeling with pen, pencil or ballpoint pen.

For television and radio equipment, a new General Electric regional headquarters office has been opened at 16247 Wyoming Ave., Syracuse, N.Y. This is one part of an expansion program involving the company's Technical Products Dept. Wells R. Chapman, formerly manager of marketing administration and product planning for the Department is in charge of the new headquarters.

Arden Inc., 534 W. 30 St., New York 1, a firm specializing in theatrical effects, has announced that it now makes all types of breakaway glass. "Anything. Windowpanes — bottles — pots and pans," the announcement states. The firm constructs props for sale or rental.

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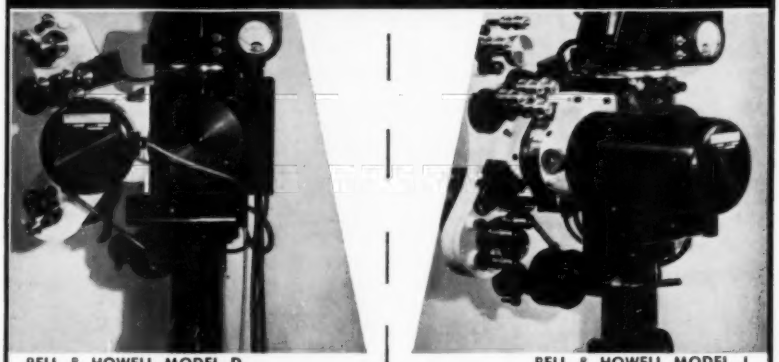

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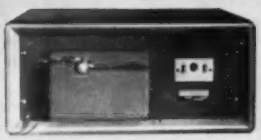

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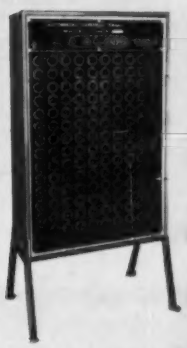

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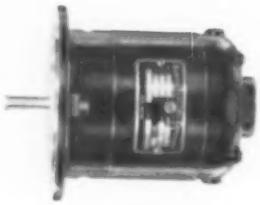

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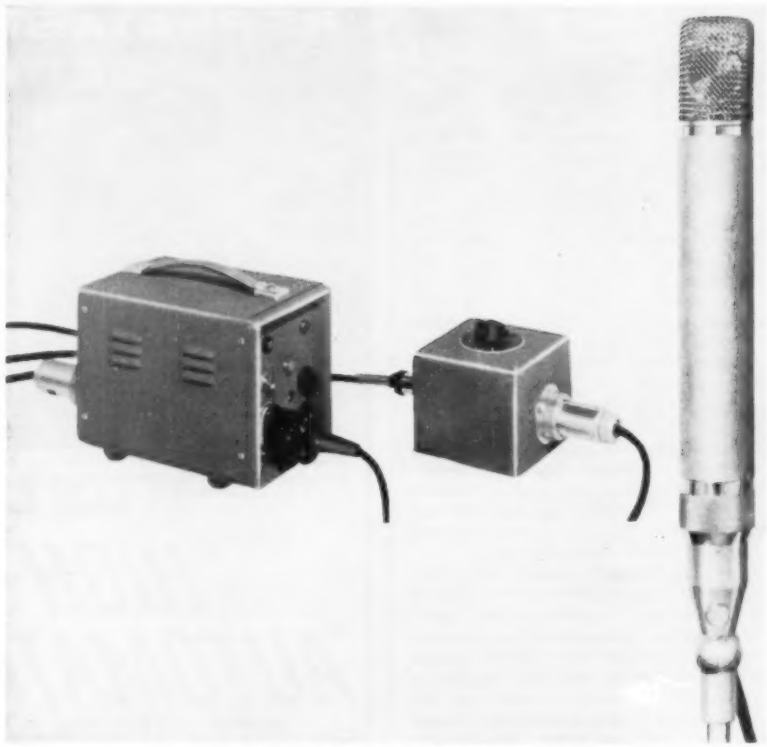
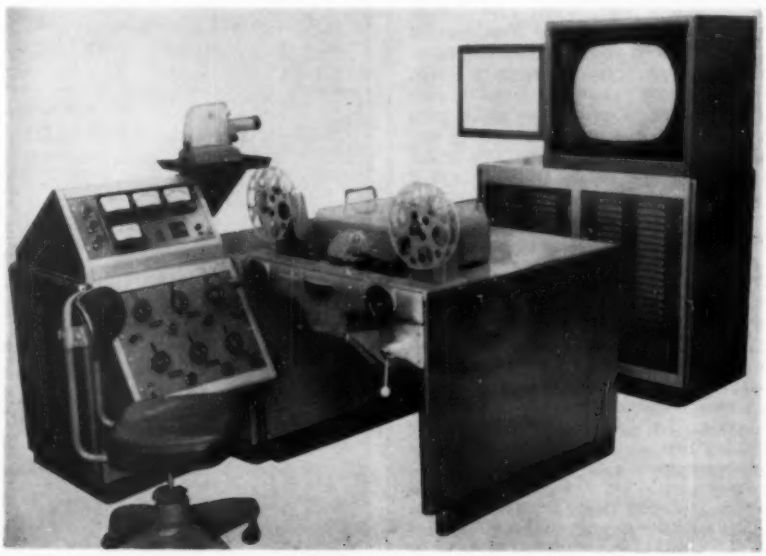


A polydirectional condenser microphone, made in Austria by the Akustische und Kinogeräte Gesellschaft, and distributed by Camera Equipment Co., 315 W. 43 St., New York 36, is specially designed for FM, high-fidelity recording and sound-film studios. Called AKG Model C-12, it features a switchbox for the remote control of directional characteristics, providing omnidirectional cardioid, figure 8 and 6 intermediary patterns. The frequency response is described as having been extended to the limits of audibility (50 to 10,000 c, ±2.5 db, and 30 to 15,000 c, ±3 db). Frequency range is from 20 to 15,000 c. The unit consists of a cylindrical metal shell which contains a condenser head, a 12AY7 tube and an input transformer. It is connected to power by a 65-ft multiconductor cable and another multiconductor cable leads from the power supply to the switchbox. The price is $775.00.



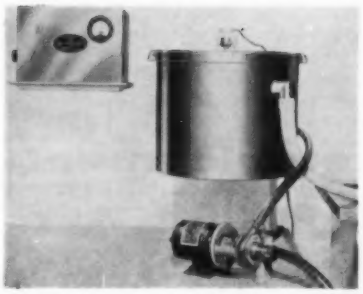
An Instantaneous Electronic Color-Film Analyzer was announced recently by Hazeltine Research Corp., 59-25 Little Neck Parkway, Little Neck 62, N. Y. Previously described in a *Journal* paper (by Messrs. Loughlin, Bailey and Hirsch of Hazeltine, and Miller and Giarraputo of Pathe Laboratories, "An instantaneous

electronic color-film analyzer," *Jour. SMPTE, 67:* 17–26, Jan. 1958), it has been demonstrated extensively and is now available as Model 1764.

The Analyzer accommodates 35mm and 16mm film widths. The range of the color controls is reported sufficient for any conditions which will be encountered, amounting in log E units to 0.75 in either direction from the central position, or a total of 1.5 in 60 printing steps of 0.025 each. The size of the electronic and optical views is approximately 12 by 16 in., and the operator is seated at about 6 ft from the viewing surfaces. The overall dimensions of the console unit are 41 by 60 by 66 in. in height, width and depth. The display unit measures 66 by 46 by 29 in. The total weight is approximately 1900 lb, and the total power 3.3 kw.

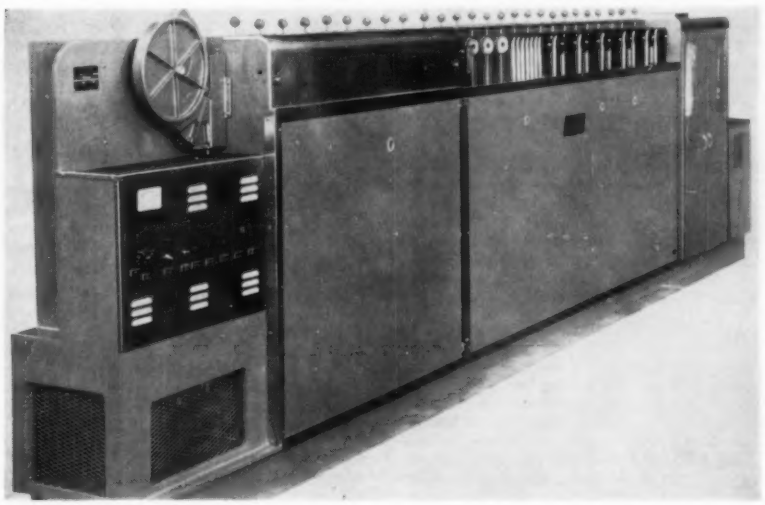
An automatic program system, V-114A, has been announced by Foto-Video Laboratories Inc., 36 Commerce Rd., Cedar Grove, N.J. Designed for unattended operation, the system, which includes the control cabinet and Foto-Videoplexer, is especially planned for news, weather, stock reports and for automatic insertion of commercials and announcements. It was field-tested for six months in the Bartlesville, Telemovie project.

A Birns & Sawyer regional sales office servicing the States of Texas, Mississippi, Louisiana, Oklahoma and Arkansas, has been established at Dallas by Birns & Sawyer Cine Equipment Co., 8910 Santa Monica Blvd., Los Angeles 46. The new office has its headquarters at the Jamieson Film Co. building, 3825 Bryan St., Dallas. Representatives to producers for the five-state area are Bruce Jamieson and Bill Stokes.



A Silver Recovery Unit, Model O-57 has been announced by Oscar Fisher Co., Newburgh, N.Y. Designed for the average processing laboratory, the unit employs the same agitation principle used in larger equipment. It gathers silver at the rate of approximately one ounce per hour with a reported operating cost of two to three cents per hour. Plugged into a 110-v a-c outlet, it is virtually automatic. The 5-gal stainless-steel tank, containing the rotation graphite electrodes, is 14 in. in diameter and is 14 in. in overall height.

Sturelab XI, a 176-page catalogue listing more than 8000 items, has been announced by S.O.S. Cinema Supply Corp. of 602 W. 52 St., New York 19; and 6331 Hollywood Blvd., Hollywood 28. Seventeen chapters, completely indexed, cover such subjects as 16mm/35mm Studio and Newsreel Cameras; Animation and Special Effects Machines; Lighting for Studio and Video; Technical Books and Stage Scenic Materials, among many others. It is available without charge to members of motion-picture and television industries and to other users of professional motion-picture equipment. Requests should be made on company letterheads.



The Color Labmaster, a color film processing machine for 16mm Eastman Ektachrome 7255, and 16mm and 35mm Anscochrome has been announced by Houston Fearless Corp., 11827 W. Olympic Blvd., Los Angeles 64. The machine is automatic and daylight operating. Speed is variable up to 30 frames/min. Features include a variable clutch drive film transport to prevent film breakage, accurate temperature control of solutions, turbulent washes, double-headed rubber wipers, air squeegee, adjustable lifter rods, filtered-air heat in the drybox and extra film magazines. It is priced at $18,500.

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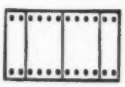

without losing a single frame of your film strip or movie film—butt splice leaders and tails—no cement or splicers needed.

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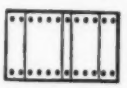

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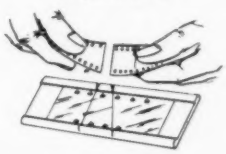

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An Intervalometer for Arriflex 16 cameras to be used in time-lapse applications or for instrumentation or data recording has been announced by Kling Photo Corp., 257 Fourth Ave., New York 10. It operates from standard 110-v, 60-cycle, a-c lines and may also be coupled to an inverter or generator and used at remote locations. It also provides for 8-v, d-c inputs. The camera may be controlled with either 110-v, a-c Ceco Time-Lapse Motor or the 8-v, d-c Arriflex time-lapse mechanism. It is available in three models, No. 3770 for 2, 4 sec or any interval from 6 sec to 20 min; No. 3771 for 2, 4 sec or any interval from 12 sec to 50 min; or No. 3772 for 2, 4 sec or any interval from 2 min to 10 hr. Dimensions are 8½ by 8¼ by 10¼ in. and the weight is approximately 14 lb. It is priced at $395.00.

A 3-stage microphone preamplifier with a self-contained power supply for raising microphone signals to line level has been announced by Altec Lansing Corp., Anaheim, Calif. Called the 1566A, it is designed for commercial systems requiring one or more microphone inputs. The input will accept high-impedance microphones and the output will drive one or more high-impedance amplifiers. It is equipped with a three-conductor power cord and cap. An auxiliary a-c convenience outlet controlled by the power switch is also provided. The preamplifier occupies only one standard rack unit of 1¾ in. The front panel contains a continuously variable gain control, pilot light, power switch and fuse.

A high-speed head for continuous black-and-white printing at 200 ft/min is described in Bulletin HH-389 available from Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N.Y. Designed to fit existing Bell & Howell Contact Printers Models D or J, the unit is priced at $5500.00 complete with lamphouse and blower.

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Engineering Photographer. B.S. degree. Twenty years professional experience. Last ten years in two large research organizations, director of photo section for several years. Experience includes commercial and industrial photography, high-speed cinematography, schlieren, 16mm motion pictures. Desires position with opportunity and challenge. Will relocate. Résumé and references on request. Write: Simeon Braunstein, 2666 Valentine Ave., New York 58.

Cameraman-Editor and Production Man experienced in educational and documentary work in Japan, Near East and U.S. Currently independent producer of community problem films but interested in camera work and challenging productions anywhere. Extensive film editing and writing background. Own 16mm equipment. Speak several languages; graduate work abroad in anthropology. Age 29, vet and single. Richard Cressey, 101 Windsor Place, Syracuse 10, N.Y.

Plant Photographer, Educational TV Broadcasting, Technical Representative. Extensive background in teaching and training TV studio personnel. Twelve years experience in TV and commercial photography. Owned and operated studio with commercial accounts. Veteran, age 33, married. Résumé and references on request. Al Victor, 150–11 14th Ave., Whitestone (57), N. Y. Tel: INdependence 1-2881.

MP-TV Production or Direction Assistant. Young man, recent graduate in Communication Arts at New York University, desires position in motion-picture or television production with active film company or TV station. Job must have a future. Age 24, married; vet, willing to relocate. Complete résumé on request. Nat Gold, 325 East 194 St., Bronx, N.Y.

Optical Effects Company owner and operator seeks change. Over 8 years experience in opticals and effects work. Familiar with all phases of processing, editing and production. Have also worked as motion picture theatre manager. Willing to relocate. B.A. in Business Administration. Age 32. Reply to: Occupant, Apt. B-32, 796 Bronx River Rd., Bronxville, N.Y.

Motion-Picture Production. Experienced in film production, studio and location, educational, industrial and TV films; some editing; extensive theatre and writing background; former CCNY Dept. of Speech lecturer; degrees in drama and journalism. Seeking permanent production assignment with production-direction future. Willing to relocate. Age 29. Résumé on request. Write: S. M. Syna, 24 East 97 St., New York. Tel: TE 1-0444.

Motion-Picture Production. Present Director of Motion-Picture Operations at a leading Southeastern University is seeking a position as production executive with a commercial motion-picture operation. College education in fields of Industrial Engineering and Speech, in addition to motion-picture and television production. Experienced in the various phases of film production, as well as labor-management relations. CAA pilot's certificate, member of SMPTE and University Film Producers Association. Complete résumé on request. Excellent references. If you need a production executive with imagination, contact: Duane K. Wacker, 2050 N.W. 7th Place, Gainesville, Fla.

Film Maker. Young man (25), college background in documentary film prod., recent radio-TV experience large ad agency, also live TV, desires position with film producer, USA or abroad. Will send documentary films with screen credits, résumé, scripts and film clips representing proficiency in camera, editing, screen-writing and client relations. Own light 16mm equipment and, through necessity, have become expert at improvising low-budget staging, set-ups and special effects. Write B.K., 2109 W. Keeney, Evanston, Ill.

Sound Engineer. Four yr experience in electronics. One yr experience as sound engineer for motion-picture producer. Married. Age 21. Write Sherald F. Brownrigg, 916 S. Glasgow, Dallas 23, Texas.

Motion Pictures. Position desired in professional motion-picture industry. Graduate Rochester Inst. Tech., May 1958, B.S. in Photo. Science. Chairman R.I.T. Student Chapter of SMPTE. Background in physics, optics, sensitometry, chemistry, photography, etc. Veteran. Résumé on request. Stan A. Feigenbaum, 207 S. Plymouth Ave., Rochester 8, N.Y.

Industrial Photographer, cameraman, producer. Broad experience incl.: still and motion-pictures production; camera, editing, darkroom, color processing, type C printing, etc. Long working practice in industrial, commercial, educational, scientific, medical and documentary fields. Have produced hundreds B & W and color films. Knowledge of production and the use of audio-visual media. Excellent background, master's degree; ambitious and reliable personally; perfect Spanish. Able to manage production unit. Have some equipment, will travel or relocate. Write M. Glikin, 68–46 Groton St., Forest Hills 75, N.Y.

Sound man desires position, preferably with educational or technical film producer. 3 yr college, 3 yr technical schooling, 4 yr motion-picture and general sound recording on film, tape, and disk. Experienced in recording, editing, mixing; sound equipment design, installation, repair. Have musical training and experience. Have own tools and test equipment. Age 25, unmarried. Will relocate. For detailed résumé, write: Donald A. Johnson, 700 Prentis, Apt. 403, Detroit 1, Mich.

Film Editor and TV Production Supervisor. 21 yr experience prod. theatricals, industrials, trailers and TV commercials, covering all phases of film production. Desire permanent position with New York organization. Résumé on request. Write William E. Kosh, 22 Willets Ave., Syosset, L.I. Tel: Walnut 1-4656, Plaza 7-6034.

Producer Cameraman — TV and Motion Pictures. 15 yr experience in motion pictures, 6 yr producing TV commercials. Desires position with active organization in motion-picture or TV production. Used to hard work and responsibility. Age 38, currently employed by large mfr. Write or call Edward A. "Jack" Price, 2417 Crest Ave., South Bend, Ind. Tel: AT 9-6839.

Sound Recording. Young man, 7 yr specialized experience film recording, scoring, mixing, sound editing; 4 yr intensive musical recording, tape, disc. Wide knowledge of music background material and selection. Prefer NYC location. Address: Sound Recorder, c/o Apt. 2-C, 51 Paulus Blvd., New Brunswick, N.J.

Motion-Picture or TV Studios, Young man (25) acquainted many phases of photography, filmstrip and slide production; 5 yr experience in motion-picture production, employed by Audio-Visual Service USOM/L, c/o American Embassy,

Beirut, Lebanon, as Program Advisor II. Experience in planning, budgeting, scheduling, purchasing and training. Worked as cameraman-director, editor of educational, documentary training and newsreel films in 16 & 35mm B & W and color. Consider any position along lines of above experience. Write: Hrayr B. Toukhanian, c/o 714 Glenwood Avenue, Syracuse 7, N.Y.; Tel: GRanite 5-4614.

Cameraman-Director-Editor. College background in all phases 16mm production; 2 yrs experience with college film production units. Desires position with commercial or industrial film producer. Will travel or relocate. Single, age 27. Have films, clips, will send resume. Write: E. B. Fleischer, 217 Hillside Ave., Cranford, N. J.

Rhodesian Producer-Cameraman visiting the U. S. October/November to examine latest motion-picture techniques, processes and equipment, offers knowledge gained during 20 yrs experience all branches film making in primitive Africa to interested organisations. Please write air mail to Geoffrey Mangin, Central African Film Unit, P. O. Box 1184, Salisbury, Rhodesia, Africa.

Positions Available

Sales Repr. — Customer Relations. Well-established, moderate-sized motion-picture laboratory with excellent reputation for quality work, both B & W and color, planning expansion program for area's growing demand. Excellent opportunity for qualified man having thorough knowledge of all phases of film processing as well as experience in customer relations and in new business development. Write Kenneth Reames, 1380 National Bank Bldg., Detroit, Mich., giving qualifications and experience and salary range.

Electronic Technician. U.S. Civil Service Commission Announcement No. 151B. Installation and maint. electronic equip. such as computers, detectors, testing and communication, also res. & dev. Grade GS3 through GS12. Salary $3175.00 to $7570.00. No written test. Apply to Executive Secretary, Board of U.S. Civil Service Examiners, National Bureau of Standards, Washington 25, D.C. Application forms available from post offices and from U.S. Civil Service Commission, Washington 25, D.C.

Chemical Engineers. Young progressive res. & dev. firm in the field of graphic information collection, storage and retrieval for use. Must have B.S. degree or equivalent and 2–4 yr experience in photo-chemistry, preferably processing techniques. Write qualifications and experience to W. R. J. Brown, ITEK Corp., 700 Commonwealth Ave., Boston 15, Mass.

Senior Physicists. Young progressive res. & dev. firm in the field of graphic information collection, storage and retrieval for use. Must have M.S. degree or equivalent and 7 or more yr experience in photo-optical design or 5 yr experience in photography with emphasis on image evaluation. Write qualifications and experience to W. R. J. Brown, ITEK Corp., 700 Commonwealth Ave., Boston 15, Mass.

Sound Engineer. Expanding 16mm film prod. company and laboratory wants man to take over its sound recording dept. Must have electrical engineering background, with thorough knowledge 16mm optical film recording using Maurer equipment. Work involves studio and location recording on ¼-in. tape and 16mm magnetic equipment, mixing magnetic tracks to master magnetic or optical tracks, some disk recording, installation of new equipment, maintenance, etc. Experience in some or all phases of 16mm laboratory and prod. work essential. In application give age, education, experience, & salary requirements. Western Cine Service, Inc., 114 East 8th Ave., Denver 3, Colo

Film Inspectors. Temporary or permanent. Write or call Peerless Film Processing Corp., 165 W. 46 St., N.Y. 36. Tel: PLaza 7-3630. Att: Kern Moyse.

Industrial Film Writers, Cameramen, Editors. Experienced industrial writer-directors, cameramen, and editors are needed for film production on aircraft and advanced projects at San Diego, Calif. Writers should have college degree and 3 to 5 yrs experience in industrial film production. Cameramen should be experienced with standard 35mm and 16mm production techniques, including sync-sound and set lighting. Editors should be experienced with all lab and editing techniques, including ability to direct dubbing sessions. Applicants should list all personal data, including past experience, employers, and salary requirements. Salary commensurate with experience and ability. Contact R. M. Hall, Motion Picture Section, Building 19, Convair, A Division of General Dynamics Corporation, San Diego, California.

Aircraft Motion-Picture Supervisor. To supervise complete in-plant production of engineering and technical films, including script preparation, directing, cinematography, sound, editing, animation and printing operations. Experience preferred in producing films related to aircraft and/or missiles programs, primarily to meet contract requirements under Air Force Table 210. Must be highly creative and imaginative in conception and execution of films in this field. Personable, tactful individual required, capable of dealing effectively with people at all levels. Write qualifications and experience to: E. Stanton Brown, Engineering Administrative General Supervisor; Convair, A Division of General Dynamics Corp., Fort Worth, Texas.

Sales and Applications Engineers, for photographic instrumentation firm selling airborne and ground data-recording equipment. Experience in aircraft and missile test instrumentation field, with optical and electronic background most desirable. Some travel required western U. S. Please address initial inquiry with brief outline of background to: Mark Macintosh, V. P., Traid Corp., 17136 Ventura Blvd., Encino, Calif.

Theatre Sound Engineer. Must have good technical background and be experienced in theatre sound work. We are expanding. Applications will be treated with strictest of confidence. North West Sound Service, Inc., 73 Glenwood Ave., Minneapolis 3, Minn.

Laboratory Quality Control. Requires thorough experience in sensitometric control methods for B&W and color raw stock (print, sound recording and camera) and developing processes. Knowledge of chemical test procedures for processing formulae and operation of temperature control systems. Ability to judge picture and sound quality. Position will be as assistant to Manager in a rapidly expanding laboratory. Send complete resume of professional background, education and salary requirements to: Dana C. Rogers, Southwest Film Laboratory, Inc., 3024 Ft. Worth Avenue, Dallas 11, Texas.

Senior Electrical Engineer (Arc and Plasma Specialist). Requires background of theoretical and experimental work in the field of high intensity electric arcs and plasma research. Development of practical devices based on arc and plasma technology in a wide range of power. Position offers an opportunity to perform research and development in association with distinguished research personnel; excellent salary and opportunity for professional growth. Laboratory located in Orange County, Calif., 10 miles from Pacific Ocean, 40 miles from downtown Los Angeles. Send resume to Giannini Plasmadyne Corp., P.O. Box 1199, Santa Ana, Calif.

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Meeting Calendar

American Physical Society, June 19–21, Cornell Univ., Ithaca, N.Y.

International Standardization Organization, Comm. 43 Acoustics, July 14–18, Stockholm, Sweden.

National Industrial Photographic Conference, July 21–25, Conrad Hilton Hotel, Chicago

National Audio-Visual Association, Annual Convention, July 26–29, Morrison Hotel, Chicago.

AIEE, Aug. 6–8, at the Hotel Statler, Los Angeles. Nonlinear Magnetics and Magnetic Amplifiers Conference.

National Bureau of Standards, Aug. 13–15, Boulder, Colo. Electronic Standards & Measurements Conf., sponsored by AIEE & IRE, National Bureau of Standards, Boulder Labs.

National Technical Conference, Illuminating Engineering Soc., Aug. 17–22, Royal York, Toronto.

Biological Photographic Assn., Aug. 18–21, at the Shoreham Hotel in Washington, D. C. Will feature award-winning display of transparencies, prints and motion pictures.

WESCON, Aug. 19–22, Ambassador Hotel, Los Angeles.

Instrument-Automation Conference, Sept. 15–19, Convention Hall, Philadelphia.

National Symposium on Telemetering, Sept. 22–24, Americana Hotel, Miami Beach, Fla.

Fourth International Congress on High-Speed Photography, including Equipment Exhibit, Sept. 22–27, Cologne.

Society of Photographic Scientists and Engineers, Annual Technical Conference, Oct. 6–10, Manger Rochester Hotel, Rochester, N.Y.

Optical Society of America, Oct. 9–11, Hotel Statler, Detroit, Mich.

U.S. National Commitee of the International Commission on Illumination (C.I.E.) Annual Meeting, Oct. 13–14, Lion Inn, State College, Pa.

National Electronics Conference, Oct. 13–15, Hotel Sherman, Chicago.

84th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 20–24, Sheraton-Cadiliac, Detroit.

AIEE, Fall General Meeting, Oct. 26–31, Penn-Sheraton Hotel, Pittsburgh, Pa.

American Standards Association, Ninth National Conference on Standards, Nov. 18–20, Hotel Roosevelt, New York.

Acoustical Society of America, Nov. 21–23, Chicago, Ill.

85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–9, 1959, Statler, New York.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles.

88th Semiannual Convention of the SMPTE, Fall, 1960, Shoreham Hotel, Washington, D. C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto.

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1958 Journal, Part II.

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  United Artists Corporation
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  Warner Bros. Pictures, Inc.
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National Screen Service Corporation
National Theatre Amusement Co.
National Theatre Supply
Neighborhood Theatre, Inc.
Neumade Products Corp.
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